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The Brooding Habit of the Blood Python and of Other Snakes

By G. K. Noble

It is generally assumed that the pythons differ remarkably from other snakes, and in fact from other poikilothermous vertebrates, in that the body temperature of the female is raised considerably over that of the environment during the brooding period. Benedict (1932) has most recently reviewed the literature, and his records of the body temperature of a brooding *Python sebae* in the National Zoological Park are the most detailed which have ever been made. It is well known that various other snakes brood their eggs but in the few instances where their body temperatures have been found higher than that of the environment the increase was apparently due to sunbathing or to activity previous to the time of capture (Noble and Mason, 1933). In the case of some lizards the brooding female protects her eggs against the attacks of enemies and this seems to be true of the majority of brooding snakes. The brooding habit of reptiles is therefore of advantage to the species whether or not the temperature of the eggs is actually raised by warmth from the parent's body.

The blood python, *P. curtus* Schlegel, is a small species. When a female recently laid in the New York Zoological Park, Dr. R. L. Ditmars called my attention to the eggs and gave me the opportunity of determining the body temperature of the brooding female. Very much to my surprise the body temperature of this brooding python was not higher than that of the environment immediately surrounding the snake. Benedict (1932) has pointed out the difficulties of recording the body temperature of snakes. Hence some statement of the precautions observed must be given.

My observations were made February 11, 1934, on a female *P. curtus*, 1672 mm. in total length, 241 mm. in greatest circumference. Immediately posterior to the head the circumference was 108 mm., while in the cloacal region it was 139 mm. The tail was only 165 mm. long and the head only 98 mm. in length. The snake was part of a lot sent to the Zoological Park by Ross Freeman from Sumatra. It had been separated from a male since December 19, 1933. About one month later it laid 16 eggs. So far as I am aware the egg laying of *P. curtus* has never been previously recorded. The day of deposition is not definitely known because the female completely covered the eggs with coils of her body. The presence of eggs was eventually suspected by the unwillingness of the snake to move from a position near the front of the cage. On February 11 seven of the 16 eggs measured as follows (in millimeters): 62×43, 65×42, 66×44, 68×40, 68×43, 58×43, 67×40. An eighth egg was obviously a double egg for it measured 85×60 mm. The other 8 eggs in the series fell within the size range of the first seven. Although subsequent examination revealed that none of the eggs was alive, the leathery shells were only slightly indented and none appeared decayed.

The body temperature of the brooding female was recorded without disturbing her. Early in the morning before visitors came to the Reptile House a cloth was gently dropped over the head of the snake and 3 mercury thermometers were employed in succession in recording the temperature of any

one spot. The most sensitive of these instruments was a gas filled mercury thermometer having a bulb 2 mm. in diameter and 12 mm. in length. It had been constructed by the Taylor Instrument Companies for recording cloacal temperatures. Noble and Mason (1933) had previously used this type of thermometer in determining the body temperatures of lizards. Since there remained a very slight but constant difference in the reading of the thermometers, I shall give only the reading of the special thermometer as it was probably the most accurate.

The brooding snake lay on a thin layer of gravel near one of the front corners of the cage. The air temperature near the center of the cage was 27.1° C. The temperature reading secured by thrusting the bulb between two of the thickest coils of the snake was 30.1° C., while the air 2 cm. above this point was 28° C. This might seem to indicate an elevated body temperature but when the bulb was thrust under the same coils in such a way that it made contact with the metal floor the reading was 32.2° C. Between 2 other coils it was 30.2° C., while the air temperature 1 cm. over this point was 28.2° C., and the metal floor directly under the snake at the same point was 32.2° C.

The thermometer was next thrust between the eggs and the coils of the parent's body. The reading was only 30° C., while the air a centimeter over this point was 27.5° C., and the gravel under the coil at the same point was 31.5° C. Between the neck of the snake and an egg the temperature was 29.5° C., while the air 1 cm. over this point was 27.5° C., and the gravel under the snake at this point was 32.2° C. From these readings and the check readings obtained with the other two thermometers it was clear that this brooding python, although undisturbed for 3 weeks had a body temperature intermediate between that of the floor and the air.

After making the above readings the snake was held firmly by the neck and tail tip while a reading of the rectal temperature was taken. This was found to be 31.8° C., only a trifle higher than the temperature between the coils. Since the dorsal skin was presumably evaporating some water while the cloacal orifice lay on the warmed gravel, a slight increase of the rectal temperature was to be expected.

It might be assumed that the particular female under observation had failed to develop an increased body temperature because she was brooding infertile or at least dead eggs. However, the *P. sebae* which Benedict so fully described was also brooding dead eggs. The "definite temperature potential between the snake and the environment of the order of 3° or 4° C." which Benedict found in this case was apparently not due to the much greater stage of putrefaction reached by his eggs at the time of examination for readings were made of the temperature between the egg mass and the coils. The evidence at hand suggests that the female *P. sebae* has an increased body temperature even while brooding putrefying eggs and this condition is not shared by the much smaller *P. curtus*.

Further study will probably show that there exists a well defined species difference in the body temperature of brooding pythons. Wall (1926) states that in the case of *P. reticulatus*, "Experiments prove that the dam's body temperature is not raised during this period." This is the more surprising in

that he records the respiratory rate of this species as "considerably accelerated" during incubation. In *P. molurus* the body temperature may be less than that of *P. sebae*. Forbes (1881) found that the temperature between the folds of a brooding female's body was in all but 5 out of 57 readings higher than the gravel temperature. Hence there is apparently a slight increase in body temperature in this species. Whether the temperature of the race ***bivittatus*** is actually higher than that of the typical *P. molurus* is still an open question as Benedict pointed out. In view of the discrepancies of the recorded body temperatures of all the large pythons new records are very much to be desired. Since the small species as represented by *P. curtus* in all probability do not experience an increase in body temperature there is probably a much greater species difference in body temperature than has been hitherto suspected.

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Winter Mating and Fighting Behavior of *Anolis carolinensis* as Induced by Pituitary Injections

By Llewellyn Thomas Evans

THE interest which the endocrinology of reptiles has awakened at the present time leads one to think that a description of the behavior of caged *Anolis carolinensis* while under the influence of injections of whole sheep pituitary extract and of Antuitrin S (human pregnancy urine extract, Parke Davis) is of sufficient interest and significance to report, especially since this differs in some respects from the behavior of caged *Anolis* as reported by Noble and Bradley (1933)[1] in their splendid contribution to the subject of lizard mating behavior.

A report has been made on the histological changes produced by these extracts in the genital organs of both the male and female of *Anolis carolincnsis*, and details presented regarding the manner in which injections were given, dosage, et cetera.[2]

Seventy-nine males and fifty females received injections of Antuitrin S between October 30, 1933, and April 4, 1934; while twenty-five males and

[1] Noble, G. K. and Bradley, H. T. The mating behavior of lizards; its bearing on the theory of sexual selection. *Ann. N. Y. Acad. of Sci.*, 35, 1933: 25–100.

[2] Evans, L. T. *Science* (in press).

twenty-five females received sheep pituitary extract between December 10, 1933, and April 4, 1934. During the entire period of this investigation a close daily observation of over 200 specimens (injected animals and controls) convinced us that only the injected males fought and then only with other males, and that no control took part in any courting activity.

Just as under normal conditions and as was to be expected, the treated males took the initiative in mating. The behavior seemed the same whether Antuitrin S or sheep extract was used, so that one description will suffice. The first courtship to be recorded took place in cage No. 1 on November 12, which was six days after the eighth injection of Antuitrin S. Several males in this particular cage were seen to strut and extend their dewlaps, and then pursue either a female or another male. The pursuing male seized his partner by the neck and after a preliminary struggle usually succeeded in pushing his tail beneath that of his partner until the two cloacae could be brought together, when coition took place. The actions of the courting male were always the same regardless of the sex of his mate. If his partner continued to struggle after the neck-bite, the pursuing male was frequently dragged up and down the cage while his two legs held on to his mate by means of the suctorial pads. This continued until the partner ceased struggling. The time occupied in actual coitus varied from about three minutes to a little over twenty minutes. On every sunny day throughout the winter and spring of 1933-34 we observed a repetition of this same performance, but only on the part of injected males.

Among our injected animals it was frequently observed that one male in a particular cage would dominate the others of both sexes. He was invariably a brilliant green while all the others were brown. He took up a position near the top of the cage where he could survey the entire group. He frequently put forth his dewlap, bobbed his head, raised his body as high as possible at the same time flattening his sides so that his belly dragged. The other lizards kept their eyes on him, the females frequently gathering about him in a ring. Suddenly he would spring at another male (often jumping as far as six or eight inches). The second male was usually quick enough to escape but if he was caught he was held in the jaws of the attacking male until he managed to struggle free. Occasionally another male would circle slowly toward the green dominating animal and strut in the familiar fighting attitude but he was quickly repulsed by the dominating male which always returned to his favorite place at the top of the cage. Such a dominating male was never seen attacking a female under such circumstances, although numerous instances are recalled in which the aggressive male deliberately walked through a group of females without disturbing them in order to attack another male farther away. It was not learned whether there was any reason why one male and not another was attacked at any particular time.

This particular domineering or aggressive behavior on the part of one male in a cage was observed in ten different cages at different times during the period of the injections, but only on the part of injected animals. It should be emphasized that it was the same male in a particular cage which assumed the dominant role from day to day. If he was removed, another male in that cage took the dominant role. If the first male was later re-

admitted to that cage, a fight resulted in which the original dominating male usually came off the victor and resumed his leadership in that cage.

If an injected male was moved to another cage containing injected males and females, the dominant male of that cage immediately assumed a fighting attitude and advanced slowly and deliberately toward the newcomer with dewlap extended, mouth open, and with body flattened laterally. The newcomer usually went into the same fighting attitude and slowly circled his adversary. The first charge was usually launched by the native which sprang suddenly at the newcomer and frequently locked jaws with him. This hold was broken only by mutual struggles and was followed immediately by another onslaught resulting in a head hold which the newcomer had difficulty in breaking. These vicious attacks against the stranger were continued until he fled the scene and hid beneath leaves and debris on the floor of the cage. We have often observed that for many days after his arrival, the newcomer was attacked repeatedly, and always conquered by the dominating male. In one case the victor stood guard on the screen in the upper part of the cage for periods well over an hour in length, daily for weeks, and whenever the newcomer emerged from cover to climb up a branch or the screen, he was immediately attacked by the conqueror and sent scuttling back to his hiding place. It should be remembered that in cases of this kind there were always other males and females in the cage and yet the leader consistently concentrated his attack on the same individual. In only one case did we observe that the newcomer came off the victor, but this was probably due to the fact that he was slightly larger than any others in the cage and thus was able to overcome the handicap of fighting in strange surroundings.

Noble and Bradley (1933: 54)[3] observed a few cases of such dominance in *Anolis* and their description agrees with our observations save that, as we have indicated, in our series the aggressive male demonstrated a consistent ability to distinguish not only between males and females but sometimes even between different males.

If we may assume from these observations that males of *Anolis carolinensis* can not only distinguish males from females but that dominating males can distinguish a strange male newly introduced into the cage from other males when none of them are in the fighting attitude, then it should follow that homosexual behavior of male *Anolis* is probably not due to an inability of the courting male to distinguish between sexes but is very likely due to some other factor. Homosexual mating has not been recorded among free-living *Anolis*. It quite possibly does occur in nature, but very rarely (as Noble and Bradley have pointed out) because the fighting instinct is strong in this genus and that naturally tends to scatter the males rather widely.

It is not unlikely that the high percentage of homosexual matings among males in captivity might be related to bodily disturbance. Caged *Anolis* undoubtedly are far less active than those which are free, unless their fighting and courtship activities are considered. The search for food, escape from enemies, defense of territory against other males, and courtship account for a large share of the activity of free-living lizards. Caged lizards have the problem of food and shelter solved for them and for this reason their ex-

[3] Noble and Bradley. The mating behavior of lizards; its bearing on the theory of sexual selection. *Ann. of N. Y. Acad. of Sci.*, 35, 1933: 25–100.

penditure of energy in these directions is relatively low. This might allow a greater amount of energy to be used in fighting and mating. If a dominant male has conquered the other males in a cage, there seems to be no other activity which will drain off his energy except that of mating. Under these circumstances it is not surprising that the mating behavior might be abnormal.

Numerous writers have pointed out that the female lizard takes no part in the courtship activity but usually runs away. For this reason they argue that the male's bright colors and courtship behavior have no significance in sexual selection. Observations made in the present study suggest that the mere flight of the female from the performing male quite probably signifies acceptance of the male and is therefore a very definite part of the complete courtship pattern and should be considered as an important phase of the mating instinct. Although her response is a negative one we need not assume that it is of negative value in leading the male to her. The flight of the female in many other vertebrates (including man) certainly makes the male more persistent in courtship.

ACKNOWLEDGMENTS

I wish to thank Professor Leigh Hoadley and Professor Thomas Barbour for their valuable suggestions and criticisms in connection with this problem.

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How Fast Can Snakes Travel?

By WALTER MOSAUER[1]

REPORTS on the speed of ophidian progression have heretofore been based on estimate or conjecture only, a fact especially true of the mechanics of snake locomotion in general. The smooth and fluent undulatory gliding so typical of serpentine movement is deceiving indeed, so that its rate was usually highly exaggerated, even by experienced herpetologists. Many scientists were inclined to share the popular opinion that some snakes, at least the fastest members of the ophidians, were swift enough to compete with the speed of other terrestrial animals or man. One author only, Lenz (1832), stated of the European snakes in his "Schlangenkunde": "Keine läuft so schnell, dass man nicht, ohne zu laufen, nur mit starken Schritten nebenher gehen könnte." When the present author worked on the mechanics of snake locomotion, he recognized the need for accurate speed tests with snakes and suggested that the staff of some zoo possessing live specimens of the fastest-running tropical or subtropical snakes would be in the best position to carry on investigations of this sort. Since nobody seems to have followed this suggestion, the writer decided to do the first step by "timing" some of our North American species. So far only six rather typical species have been considered, but it is hoped to include eventually many of our native and possibly some exotic snakes.

The problem involves determination of two values: first, the maximum

[1] Contribution from the Department of Zoology, University of California at Los Angeles.

speed of every species considered, but especially of fast-running forms—records which would be of interest both to zoologists and lay public; secondly, an average speed such as the snake would attain in prowling and travelling undisturbed—records which perhaps are of greater significance than the former.

The snakes used included:

1 California boa, *Lichanura roseofusca roseofusca* (Cope);
4 Red racers, *Coluber flagellum frenatum* (Stejneger);
1 Patchnosed snake, *Salvadora hexalepis* (Cope);
4 Gopher snakes, *Pituophis catenifer annectens* (Baird and Girard) and *P. c. deserticola* Stejneger;
1 Coral king snake, *Lampropeltis multicincta* (Yarrow); and
7 Sidewinders, *Crotalus cerastes* Hallowell.

The speed of the gopher snake and king snake, powerful but rather slow moving species, may represent a fair average for the locomotor velocity of snakes in general; the red racer represents the extremely slender and elongated speediest members of the ophidians, while the California boa is a good example of the other extreme. The sidewinder, an especially agile species of the Crotalidae, is interesting because of its specialized type of locomotion. In the three species in which more than one specimen was used, a considerable range in size existed, but the speed did not seem to vary significantly with the size of the individuals, so that the results of all trials with the same species were lumped in the graph accompanying this paper.

In order to obtain a true picture of the locomotor faculties of these snakes, it was necessary to find a surface which would offer them the optimum conditions—horizontal ground, not too irregular, yet rough enough to furnish sufficient resistance or "purchase." Some of the species were tested in their natural desert habitat: the red racers on level, hard ground with small stones and pebbles, or on coarse, packed sand; the sidewinders on the latter surface and on smooth stretches of fine dune sand. Most other records were obtained on the campus of the University on level firm ground partially covered with small plants, where conditions seemed to be optimal. The velocities attained by the six species investigated are listed in the order of their relative maximum speed.

TABLE I

No.	Specimen	Trials	Prowling		Maxima	
			m/sec	mi/hr	m/sec	mi/hr
1	*Lichanura*	7	.040	.090	.100	.224
2	*Lampropeltis*	12	.077	.173	.321	.720
3	*Pituophis*	36	.060	.134	.530	1.180
4	*Salvadora*	12	.100	.224	.638	1.430
5	*Crotalus*	41	.140	.313	.910	2.040
6	*Coluber*	39	.128	.286	1.61	3.60

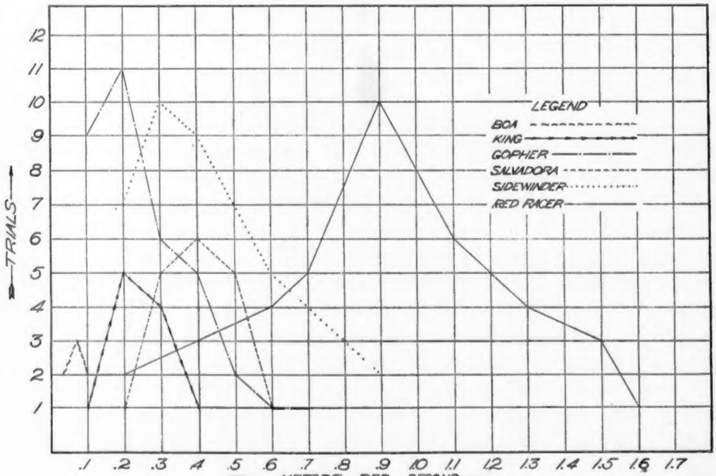
It is seen that the maxima were the fastest of many trials made, and should represent a fair picture of the snake's running capacity. Undoubtedly, greater speed may be shown by vigorous and excited specimens during short bursts of speed, but such extreme exertion seems to fatigue the snakes rapidly. If several successive trials were made at short intervals with the

same snake, the second trial was practically always slower than the first, the third slower than the second, and so on.

TABLE II

Trial	*Coluber*	*Crotalus*	*Pituophis*
1	1.3 m/sec	.673 m/sec	.132 m/sec
2	1.07 "	.430 "	.119 "
3	0.68 "	.740 "	.044 "
4		.070 "	.113 "
5		.397 "	.019 "
6		.407 "	

From this table it is seen that the sidewinder does not seem to become fatigued as rapidly as the other species, a fact which agrees well with the extensive ramblings of this desert rattler.



It is difficult to judge, however, whether the decrease in speed in successive trials is due to actual muscular fatigue or only to a lessening value of the stimulus administered in prodding.

The prowling speeds of the six species are represented by the lowest values in Table I; it may be seen that they are surprisingly slow. Of course the rate of undisturbed travelling may vary in the same individual by as much as several hundred percent, so that the figures given can mean no more than indications of the average leisurely speed of these species. Nevertheless it is certain that in prowling the boa hardly exceeds one tenth of a mile per hour and that the prowling speed of the other species may be expressed in terms of a few tenths of a mile per hour.

This extreme slowness is only to a small part due to the habit of the snakes of stopping at intervals and hesitating for a moment before continuing on their way.

Although the author believes it possible that any of the six species investigated may exceed the speeds recorded here possibly by as much as 50 per cent in exceptional cases (sudden lunges over short stretches), it is reasonable to assume that the average maximum speed (*sit venia verbo*) of the red racer is approximately 1.5 m/sec. or 3 miles per hour, while the average prowling speed is not more than 0.13 m/sec. or ¼ mile per hour. Some tropical snakes, reputed for their running faculties, undoubtedly attain higher velocities, yet it is the author's belief that actual tests with measuring tape and stop watch would bring about disillusions in these cases as well. It seems safe to conclude that under conditions equally favorable to both, man can outrun any snake of the world.

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On the Supranasal Sac of the Viperinae

By W. GARDNER LYNN

IN a previous paper (Lynn, 1931) the morphology and innervation of the so-called "pit-organ" of Crotaline snakes were discussed. This structure, which is not a simple pit but a comparatively complex organ, has an extremely rich nerve supply derived from the ophthalmic and supramaxillary branches of the trigeminal nerve. It is present in certain snakes of the family Crotalidae and forms the basis for separation of this group into two subfamilies; the Crotalinae, in which the pit is present, and the Viperinae in which it is lacking. Aside from this striking characteristic the two subfamilies constitute a well unified group. This being the case it is of great interest that structures of somewhat the same character as the pit-organ have now been noted in some members of the Viperinae. Schmidt (1930) in describing a new species of *Pseudocerastes (Pseudocerastes fieldi)* from Transjordania calls attention to the presence of a pocket-like invagination just above the nostril, and Parker (1932) gives an excellent description of this sac-like structure lying under the supranasal scute which he has found to be present also in all the species of *Bitis* examined as well as in *Pseudocerastes persicus*. He finds that the ventral wall of this sac is supplied with branches from the ophthalmic branch of the trigeminal and therefore suggests the possibility of a relationship between this structure and the Crotaline pit. The existence of this sac in *Bitis*, where it is best developed, was apparently already known to Boulenger at the time of the publication of his "Catalogue of the Snakes in the British Museum" (1896) for in his description of the genus is to be found the following: "nostrils directed upwards and outwards, pierced in a single or divided nasal, with a deep pit or pocket above, closed by a valvular, crescentic supranasal."

In the present paper I desire to report the results of dissection of this structure in a number of Viperine snakes[1] with a view to throwing some light upon the possible homologies. As Parker has stated, the sac lies beneath the supranasal scute in such a way as to make it appear as though the supranasal

[1] My thanks are due to Mr. Karl P. Schmidt and to the Field Museum of Natural History, Chicago, for an opportunity to examine and dissect specimens belonging to that institution.

imbricates the nasal, but its innervation and the extent of its development in many forms make it unlikely that this explanation is the true one. I have found it to be present in *Pseudocerastes* and *Bitis* as previously recorded and also in snakes of the genus *Causus*. In no other genus of the Viperinae could any trace of it be found.

It is very well developed in the various species of *Bitis*, in *Bitis nasicornis* even extending into the base of the "horn" (Fig. 1). In *Causus*, on the other hand, it is narrow and underlies only a very small part of the internasal scute (Fig. 2). In every case however it is a simple invagination showing nothing of the complexity of structure which is so striking in the facial pit of the pit vipers.

Detailed dissections of the course of the trigeminal were carried out on *Bitis arietans, Bitis gabonica, Bitis nasicornis* and on *Causus rhombeatus*. The distribution of the various branches of the nerve was found to be essentially the same in all four of these species so that a description of the condition in one, *Bitis arietans*, will serve for all. In snakes the trigeminal has three main branches. The first, the ophthalmic branch, runs anteriorly a considerable distance before emerging from the skull and possesses its own ganglion separate from the common ganglion of the other two branches. The second and third branches, the supramaxillary and inframaxillary, diverge from their common ganglion and leave the skull through separate foramina in the prootic. The common blacksnake *Coluber constrictor* may be selected as a type for a description of the usual distribution of these nerves. In this species the inframaxillary passes postero-ventrally beneath the temporal muscles and external to the transverso-maxillo-pterygo-mandibular muscle to the angle of the jaw and thence to the lower jaw. The supramaxillary at its emergence from the skull sends a small branch between the anterior temporal muscle and the posterior border of the orbit to supply the skin behind the eye. Small threads run into the temporal muscle as the main trunk passes ventrally to the posterior ventral border of the orbit. Here there arises a superficial branch which passes anteriorly along the poison duct and supplies the skin along the upper lip. The main nerve runs more deeply, ventral to the eye and sends off regular small branches along the roof of the mouth. The ophthalmic branch is the most important one for our present purpose. In the blacksnake this branch after leaving the main trigeminal trunk runs forward inside the cranium, expanding to a small ganglion at the level of the posterior end of the optic lobes. At the posterior border of the orbit it leaves the skull in company with certain of the eye muscle nerves and passes behind the eye. At the anterior edge of the orbit it passes through a second foramen into the nasal cavity. Here it lies close to the olfactory bulb at the point where it gives rise to the bundle of branches which constitute the olfactory nerve. The ophthalmic then divides into two branches. One passes ventral to the olfactory nerve and runs along the nasal septum to the very tip of the muzzle. The other runs directly to the skin above and to the sides of the nostril where its ultimate branches are distributed. In the pit-vipers the last-mentioned branch varies its position slightly to supply the facial pit but it is the supramaxillary which shows the greatest modification, devoting almost its entire bulk to innervation of that structure. In the case of the viperine

supranasal sac however, as Parker has pointed out, the ophthalmic branch alone furnishes the nerve supply and little modification of the usual course of the trigeminal is apparent. Dissection shows that the distribution of inframaxillary and supramaxillary branches in *Bitis* is essentially the same as that in *Coluber* so that only the course of the ophthalmic branch in the former need now be considered. This is diagrammed in Fig. 3. As can be seen the distribution of this nerve in *Bitis* is very similar to the condition in the blacksnake. A slight difference is apparent in that the branch which runs to the

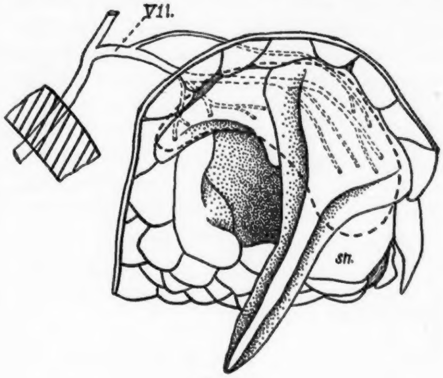

Fig. 1

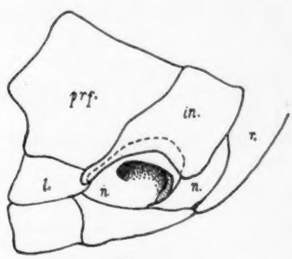

Fig. 2

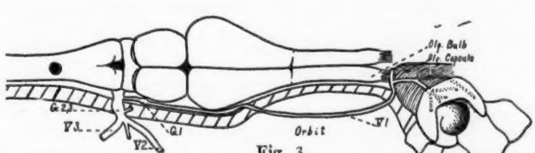

Fig. 3

Fig. 1. Nasal region of *Bitis nasicornis* to show the position and extent of the supranasal sac. sn., supranasal scute; VI l, lateral element of the ophthalmic branch of the trigeminal nerve. The supranasal sac is outlined by a heavy broken line and the ultimate distribution of the nerves on its floor is indicated.

Fig. 2. Nasal region of *Causus rhombeatus*. Position and extent of supranasal sac indicated by broken line. prf., prefrontal scute; in., internasal; l., loreal; r., rostral; n., nasal.

Fig. 3. Diagram of the innervation of the supranasal sac in *Bitis arietans*. V 1., ophthalmic branch of the trigeminal nerve; G. 1., its ganglion; V 2 and V 3, supramaxillary and inframaxillary branches of the trigeminal; G. 2, 3; common ganglion of supramaxillary and inframaxillary branches.

tip of the snout passes dorsal to the olfactory nerve rather than ventral to it but this is true also in the Crotalinae. The second branch of the ophthalmic furnishes the nerve supply to the supranasal sac (Fig. 3). This is, however, the region which that branch normally supplies so that no change in its distribution is necessitated. Parker reports that no specialized nerve-endings could be seen in the lining of the sac nor did sections of the head of an embryo *Bitis arietans* show any modification of the epidermis that would indicate a sensory function for the structure. On the basis of the evidence

here presented it would seem unlikely that any true homology exists between the supranasal sac of the Viperinae and the facial pit of the Crotalinae. The two differ markedly in their morphology and anatomical relations as well as in innervation. It is not surprising that both are innervated by the trigeminal since this nerve furnishes the chief supply for sensory endings of the whole surface of the head. That there is some concentration of nerve endings in this region is not to be denied but it is extremely slight as compared with that in the region of the facial pit of the pit-vipers or even as compared with the concentration of nerve endings in the labial pits of the pythons and boas. The conclusion seems justified that in these three groups of snakes, the Crotalinae, the Viperinae and the Boidae we have three separately evolved types of sense organs all possessing trigeminal innervation.

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The Mechanics of Respiration in Turtles[1]

By Ralph J. Shaw and Francis Marsh Baldwin

THE visible movements concerned with respiration in the turtle have been the source of discordant observation. As early as 1719 Malpighi described the distention of lungs of the turtle by swallowing air in a manner similar to that employed by frogs. Many later writers have continued to describe a deglutory mechanism assisted by movements of the head and legs. Inspiration and expiration by means of changing the capacity of the lungs by contraction of muscles situated entirely within the exoskeleton was first described by Townson in 1795. Mitchell and Morehouse (1863) repeated Townson's early experiments, using techniques of modern experimental physiology, confirming many of the original observations, and making a detailed study of the innervation of the inspiratory musculature which is located ventrally in the flank regions. The less powerful expiratory musculature was found to be located ventral to the digestive viscera. More recently Lumsden (1924) has reported experiments which have served to locate the brain centers for respiration in the turtle, and has studied the effects of anes-

[1] Some of the data contained in this paper were presented before the Pacific Division of the American Association for the Advancement of Science, Herpetologist Section, Eugene, Oregon.

thetics, temperature, and composition of respired gases on the respiratory movements. Using an improved form of the *kopfkappe apparatus* described by Siefert (1896), the writers have made graphic records in a study of the respiratory movements and of the extent of the periods of apnea which occur between the intervals of lung ventilation.

The apparatus (Fig. 1) used in our laboratory consisted of a six liter reservoir (gasometer) connected in series with a light rubber sleeve to be fitted around the turtle's head, and with a recording tambour. Capillary intake and outlet valves were inserted in the circuit in order to make the tambour sensitive to small changes in pressure and to permit an adequate flow of air (or other gas mixture) through the circuit at all times. The rate of flow was usually less than 50 cc. per minute except when respiratory movements were taking place. At such times the rate of flow was around 150 cc. per minute. Records of respiration were made upon a kymograph drum revolved at a very slow speed, and for detailed analysis of movements at a faster speed.

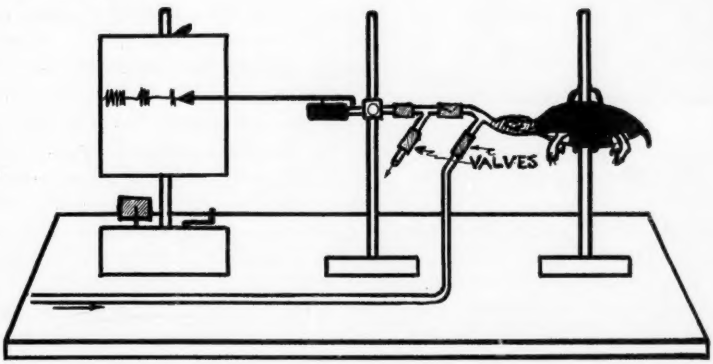

Fig. 1. Apparatus for Recording Respiratory Movements.

Concerning the sequence of movements in a respiratory cycle, our observations are in qualitative agreement with both Mitchell and Morehouse, and with Lumsden but supplement them in certain particulars. A period of apnea is always broken by expiration (upstroke, Fig. 2). This expiration is complete, but not forceful. After a very short pause it is followed by a very full inspiration and a partial expiration. When several respiratory cycles occur in succession, expiration, inspiration and pause follow each other without interruption until the end of the period of lung ventilation is reached. At the end of such series the partial expiration occurs leaving the lungs filled but not too greatly distended. The average time (22 observations) of a single complete cycle under experimental conditions was found to be:

Expiration	2.2 sec.
Inspiration	1.5 "
Pause	.24 "
Total	3.94 sec.

It is thus evident that approximately 70 per cent of the time of the cycle is

occupied by expiration. Time for the first expiration at the beginning of a series of cycles was on the average 1.3 seconds (8 observations). Average time for the final partial expiration at the end of the series was 1.6 seconds (8 observations). Under conditions of low oxygen tension, 6–8 per cent O_2, the duration of individual cycles was shortened to as little as 1.5 seconds, time being almost equally divided between expiration and inspiration, and the pause having been abolished. Amplitude was materially increased by low oxygen tension.

It was interesting to note in normal respiration the occurrence of several series of cycles at the time of each ventilation. Between each series a period of apnea of approximately 10 seconds intervened. The number of series most frequently recorded was eight but variations from three to eighteen were observed. Furthermore the number of cycles in each series was not constant. The first series was usually one or two cycles followed by a period of apnea of 40–200 seconds duration. The second series consisted most frequently of two or three cycles. From this point onward in the records the number of cycles increased progressively in each succeeding series until a certain maximum number, usually 7 or 9, was reached. Subsequently the number of cycles per series decreased to three or four, but never to two or one. After such a period of thorough ventilation a long period of apnea ensued.

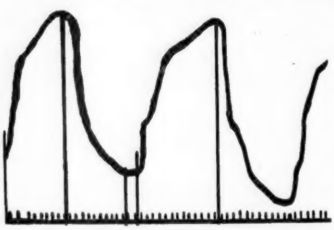

Fig. 2. Respiratory cycles of turtle. Upstroke; Expiration. Time interval = $\frac{1}{5}$ second.

Under our experimental conditions, which we believe to be optimal, inasmuch as the turtle was removed from as many extrinsic stimuli as possible, the duration of the long periods of apnea was most frequently between twenty and thirty minutes. These observations place the length of such periods of apnea well below the maximum submersion time of from several hours to two days reported by Owen (1866). It should be borne in mind, however, that long submersion is likely to be the result of such factors as fright, low temperature, or excessive food intake. When our experimental animals were placed in the apparatus for the first few times, there was a tendency to fright with periods of apnea lasting nearly three hours recorded. After becoming accustomed to being handled, the turtles exhibited very little tendency toward excessively long periods of apnea.

The ability of the turtle to extend a period of apnea over several hours is made possible by several factors, most important of which are:

Very thorough lung ventilation. The sequence and duration of the respiratory movements have been described in this paper.

Low oxygen consumption. Baldwin (1926) has reported data which fixes the average basal consumption of *Chrysemys bellii marginata* at 0.026 cc. per gram of body weight per hour. Such oxygen consumption is very low, being less than the rate of consumption of many similar poikilotherms.

A low "unloading tension" for turtle hemoglobin. Macela and Seleskar (1925) have placed the oxygen carrying power of turtle hemoglobin below that of the hemoglobins of birds and mammals, but point out that it dissociates rather freely at low temperaures.

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The Food of *Rana catesbeiana* Shaw

By S. W. FROST

THE food preference of *Rana catesbeiana* was determined by dissection and by observing feeding activities. Available information shows that, as a rule, small frogs eat small insects and conversely. Spring-tails, flies, ants, leaf-hoppers and similar insects are the favorite food of the smaller species such as *Hyla crucifer* or the smaller specimens of other frogs. A full grown bullfrog can scarcely be tempted with an insect as small as a fly or a honey-bee, unless it is exceedingly hungry. Large moths, grasshoppers, and cicadas are accepted but they prefer crayfish, frogs, mice or birds. Although Dickerson (1907) remarks that bullfrogs are known to eat young water birds, and Haber (1926) cites a reference where a swallow was taken, birds are a somewhat rare diet in nature. Surface (1913) summarizes the food, determined by the dissection of 39 bullfrogs, as follows: 29 contained food which included earthworms, crayfish, spiders, insects and a young frog. Holbrook (1842) states that insects and small animals, such as crayfish and snails, constitute the food of the bullfrog. Wright (1920) says that small fish, young ducklings, sparrows, snakes and a young alligator have been taken from bullfrog stomachs. Palmer (1908) is one of few who found a mouse in the stomach of a bullfrog. Dickerson (1907) adds the turtle to the list of food of *Rana catesbeiana*. It is interesting to note that the writer offered a snapping turtle, measuring one and three-quarter inches, to a bull-

frog but he refused to eat it.[1] As a matter of fact the turtle and the frog lived together all summer, often occupying the same eight-inch pond. The turtle in turn attacked and killed two of the smaller frogs which were placed in the cage as food for the bullfrog. Needham and Betten (1901) give the stomach contents of one bullfrog but add nothing to the knowledge of the food of this species.

The writer dissected twenty-five bullfrogs. Insects constituted the chief food of the smaller specimens. Ants were eaten in considerable numbers, three hundred and forty-one were taken from six specimens. Spiders and snails, however, formed the largest proportion of food by volume. Frogs, crayfish and mice were the principal food of the larger specimens. Crayfish were taken from four specimens, frogs from two and mice from two. Incidentally, crayfish and small frogs were taken from the stomachs of large specimens of *Rana clamitans.*

Frogs can endure long fasts and no doubt may be compelled to wait a considerable time for food in their natural habitat. This is especially true of the bullfrog which can take a large meal, such as a mouse, and can wait a long time for the next. In captivity frogs may eat more than they do in nature. Although they feed freely, there is a great difference in the willingness of species or individuals to accept food under artificial conditions. References to the feeding of frogs are few and it seems advisable to include notes on species other than the bullfrog. Toads take food readily and for this reason are recognized as pets. The witches of the old world made companions of them as they did of cats. According to Roth (1908–9) the Indians of Guiana kept live frogs to predict rain, to assist in the hunt, and to provide food. The Zuni priests kept diminutive toads (*Bufo punctatus*) in their *etó we* for ceremonial purposes, Stevenson (1901–2). It is said that they were fed regularly at each meal by some woman in the house where they were protected and were removed only for retreats held in their honor. Bunzel (1929–30) calls them miniature frogs, intimating that they are probably frog effigies. Beard (1904) warns young enthusiasts not to put a large frog in an aquarium for it will devour everything. He continues to enumerate the food taken by a single bullfrog which he kept in his studio. This includes: 10 full-grown mice, 1 frog, 3 crayfish, 1 young alligator, 92 insects and other food. Miller (1909) observed that a toad took from 90 to 100 rose-beetles at a single feeding. Metcalf (1930) studied a medium-sized toad, *Bufo fowleri,* at a porch light when *Phyllophaga* (*Lachnosterna*) *ephilida* Say was swarming. On July 19, 43 beetles were taken in 1 hour and 5 minutes, on July 20, 34 beetles were taken in 43 minutes, on July 21, 37 beetles were taken in 1 hour, on July 22, 30 beetles were taken in 1½ hours, and on July 23, 26 beetles were taken in 2 hours. The flight of the may beetles, also the experiment, ended July 24 with a total of 170 beetles eaten in five days. He remarks that the first fifteen or twenty beetles were taken with much relish, then considerable coaxing was necessary to get the toad to eat more, and that a single toad might eat 4200 may beetles in a season of four months. Frost (1932) gives notes on the feeding of several species of frogs.

[1] A bullfrog from North Carolina in the Museum of Zoology, University of Michigan, collection, contained four *Sternotherus odoratus,* straight lengths 22–23 mm., in the stomach.—Ed.

The writer placed a bullfrog, weighing approximately 200 grams, in a cage three and a half feet long, one and a half feet wide, and one foot deep, with glass on three sides and wire screen on the fourth. The bottom of the cage was covered with three inches of sand and the top with a piece of glass. The cage was provided with a small pond eight inches in diameter. Live food was offered as frequently as the frog seemed willing to accept it. During the summer, over four hundred and twenty-seven grams of food was eaten by this frog. Under these conditions feeding is unnatural and the frog may have eaten more than it would have otherwise.

The bullfrog has a singular method of accepting its food, preferring to take it under water. Sometimes it snatches a morsel of food on the bank of a stream or pond but invariably jumps into the water and submerges to swallow. This has been observed a number of times in nature and in captivity. In one instance, a twenty gram frog was grabbed by the head and front legs. The specimen was too large to be swallowed in one gulp and the bullfrog did not jump into the pond. More than twenty minutes elapsed before the frog was completely swallowed. Large insects were lapped up with one lick of the tongue. Even large *Promethia* moths were gulped almost too rapidly to be observed. The wings were crumpled and eaten and not discarded as a smaller frog would attempt to do. Nestling birds were taken with a single lap of the tongue and disappeared from sight in a few minutes. Although sixty boney animals were taken during the summer, only small pieces of bones could be found in the cage. The material was well digested and the most of the remains were found in the bottom of the pond.

Food Eaten by a 200 Gram Bullfrog

June 9, 2 snails, 11 grams; June 12, 3 beetles; June 15, 1 frog, 5 gm.; June 17, 1 frog, 5 gm.; June 20, 1 frog, 1.5 gm.; June 21, 2 snails (*Limax*), 10 gm.; June 22, 2 Promethia moths; June 23, 2 Promethia moths, 8 insects; June 24, 1 Promethia moth, 3 insects, 1 nestling sparrow (18 gm.); June 25, 1 frog, 6 gm.; June 26, 2 frogs, 13.5 gm.; June 27, 1 snail (*Limax*), 5 gm.; June 29, 3 snails, 15.5 gm.; July 1, 1 grasshopper (1 gm.), 1 frog (4.5 gm.); July 4, 1 nestling sparrow, 17.5 gm.; July 5, 1 nestling sparrow, 20 gm.; July 6, 1 snail (*Limax*), 4.5 gm.; July 17, 1 insect; July 18, 3 frogs, 10.3 gm.; July 22, 1 frog, 1 gm.; July 23, 2 grasshoppers (1 gm.), 1 frog (7.5 gm.); July 25, 18 caterpillars (3 gm.), 2 snails (*Limax*, 7.5 gm.); July 28, 1 grasshopper, 1 gm.; July 29, 10 frogs, 15 gm.; July 30, 1 frog, 12 gm.; July 31, 1 toad, 10 gm.; Aug. 1, 6 insects, 3 cicadas (12 gm.); Aug. 2, 2 insects; Aug. 3, 3 cicadas, 9 gm.; Aug. 5, 1 grasshopper (1 gm.), 1 cicada (3 gm.), 1 frog (2 gm.); Aug. 6, 1 frog, 20 gm.; Aug. 9, 1 grasshopper, 1 gm.; Aug 11, 1 cicada, 4 gm.; Aug. 14, 3 frogs, 13 gm.; Aug. 23, 1 snail (*Limax*), 5 gm.; Aug. 24, 1 frog, 16 gm.; Aug. 25, 1 frog, 8 gm.; Aug. 26, 1 frog, 2 gm.; Aug. 27, 1 frog, 3 gm.; Aug. 28, 1 frog, 15 gm.; Aug. 30, 2 wasps; Sept. 4, 1 toad, 2.5 gm.; Sept. 5, 1 frog, 3 gm.; Sept 7, 1 wasp; Sept. 9, 1 frog, 1.5 gm.; Sept. 10, 1 frog, 20 gm.; Sept. 20, 1 salamander (1.5 gm.), 4 frogs, (8.5 gm.); Sept. 24, 1 frog, 1 gm.; Sept. 26, 1 toad, 3 gm.; Oct. 7, 1 frog, 12 gm.; Oct. 8, 2 frogs, 4 gm.; Oct. 9, 1 frog, 2 gm.

Total, 427.3 grams.

The voracity of the bullfrog is unbelievable. It has a tremendous mouth, large tongue, and muscles capable of seizing and retaining animals of considerable size. The table above gives some idea of the enormous amount of food that can be eaten by a single bullfrog. It illustrates the impossibility

of raising bullfrogs artificially unless large swampy areas are available where natural food is abundant.

The bullfrog, under observation, took more than its own weight of food in less than five months. This food included: 56 amphibians, 63 insects, 12 snails (*Limax maximus*), and 4 birds. After October 9, the frog refused to eat more although food of various sorts including insects, snails and frogs was offered. During October the night temperatures were below 60° Farenheit and the frog was apparently ready to hibernate. The day temperatures were higher and the frog wandered about the cage as if seeking a place to hibernate. The color of the skin changed from a brilliant green to olive or dark brown. October 27, 28, and 29 were very cold and the frog spent most of the time in the pond. Several warm days followed October 30. The green color returned and the frog became active once more but refused to eat. On November 1 it was placed in a box of leaves and sand for the winter.

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Rediscovery of *Biat luzonicus* Seale (Gobiidae)[1]

By Hilario A. Roxas

IN June, 1907, a unique goby was collected by W. B. Carpenter from the east coast of Luzon, Philippine Islands, and was deposited with the government collection of the former Division of Fisheries of the Bureau of Science, now the Fish and Game Administration, Department of Agriculture and Commerce. Seale in 1909 used this lone specimen to create a new genus and species, *Biat luzonicus, Biat* from *bia,* the Tagalog word for goby and *luzonicus* for the island where the animal was found. Although this genus and species were redescribed by Herre in 1927, the Carpenter specimen was the only one known. On April 11, 1934, however, a second specimen was obtained by the use of hook and line at Port Galera Bay on the northern coast of the island of Mindoro. The specimen was obtained among some corals in water about eight fathoms deep. Color notes were made soon after the fish was caught.

The description below, although confirming those by Seale and Herre in general, is given as the measurements and counts were made on the freshly caught fish. It also gives accurate information on the natural coloration of the animal.

Biat luzonicus Seale

Biat luzonicus Seale, Phil. Journ. Sci., (A) 4, 1909: 532.

Biat luzonicus Herre, Gobies of the Philippines and the China Sea, 1927: 246, pl. 20, fig. 1.

Head 4; depth 5.3; dorsal V, I—16; pectoral 20; ventral I, 5; anal I, 18; caudal 20; scales 108 in median lateral series, 30 in vertical series counted from origin of ventral to middle of dorsal; 25 small, indefinite predorsal scales.

Body elongate, almost straight, the ventral profile slightly more convex than the dorsal; greatest depth at level of first dorsal and ventral; body tapering gradually to caudal base the depth of which is slightly less than its length and about 2.6 in head.

Head more or less blunt, with a width greater than its depth. Profile from nape to snout well arched almost to an angle of 45 degrees. Mouth terminal, but slightly oblique, the lower lip slightly greater than the upper. Teeth in five series in the upper jaw; those of outer row large, canine-like, curved and widely separate; teeth of the inner series tiny, fine-pointed and imbedded in a fleshy cushion. Teeth in lower jaw in 3 to 4 rows; those of the outer row larger and caniniform; those of the inner tiny and closely set; several in the innermost row also canine-like and even larger than those of outer row. Tongue short, more or less truncate. Both lips thick and fleshy with very tiny, irregular, highly pigmented fringes. A prominent, irregular, deep and wide groove runs a short distance behind and parallel with upper lip. Maxillary visible. Chin prominent and well arched. Eyes large, 4 in head, about equal to snout, impinging on dorsal head profile. Anterior nostril small, tubular, halfway

[1] Contribution No. 9 from the Fish and Game Administration, Dept. of Agriculture and Commerce, Philippine Islands.

between front edge of eye and snout. Posterior nostril larger, halfway between anterior nostril and front edge of eye. Rows of minute mucous openings radiate from front margin of eye. Interorbital space narrow, less than eye diameter. A prominent supraopercular groove runs from orbit to dorsal edge of opercular opening. Operculum wide and carried forward to below level of preopercle. Both opercle and preopercle smooth. Pores found at following places: one above and between the nostrils; one at interorbital between front edge of eyes; one at interorbital between hind edge of eyes; one behind upper part of eye; one behind middle of eye; and three on posterior margin of eye. Three branchiostegal rays prominent and much visible externally with prominent grooves between them. Gill-rakers abortive, short and pectinate, 9 on lower limb of outer arch.

Scales fine and inconspicuous anteriorly becoming larger and prominent posteriorly, largest at caudal peduncle. Scales distinctly ctenoid, with about 26 pointed spines at the exposed end and 16 to 18 lines at the hidden posterior portion.

Spinous dorsal with a base 1.2 in head. Spines soft and pointed, fourth longest, about equal base. Soft dorsal origin more advanced than that of anal, with the penultimate ray the longest. Height of soft dorsal about 2 in head. Pectorals with rather thick bases, shorter than head, the central rays the longest. Ventrals fused, the frenum broad, forming a deep sucking disk; the rays much branched, dichotomously at places, the central rays almost reaching the anal. Base of anal fin about 1.2 in that of soft dorsal, the last rays the longest, about 1.8 in head. Posterior tip of both anal and soft dorsal reach caudal base when depressed. Caudal more or less lanceolate, about 1.2 times greater than head. Base of caudal covered with scales.

Body with a light yellowish ground color, with five wide transverse dark brown bands without distinct margins, only slightly narrower than the interspaces; first across the nape, descending down through the opercle; second from middle of spinous dorsal to belly; third across body from anterior portion of soft dorsal to anterior portion of anal; fourth in front of caudal peduncle, from hind part of soft dorsal to hind end of anal, and fifth at base of caudal fin. Dark blotches on snout and interorbital space. Prominent yellow spots on head, on vertex and below eye. Light yellowish spots arranged in rows on lower part of cheek. Pectoral rays light golden yellow. Fused ventrals bluish black with yellowish rays. Edge of anal with three bluish lines with light coral red between them. Lower margin of caudal with two bluish lines with coral red between them.

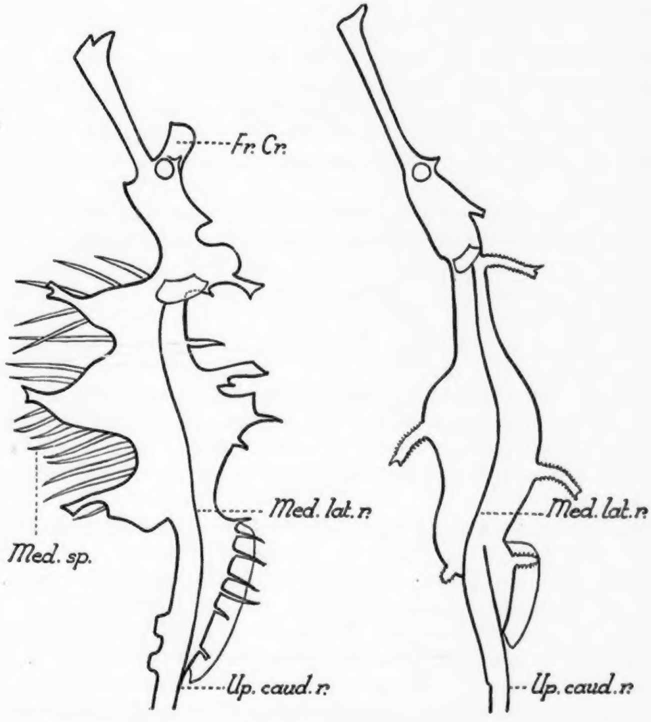
Here described from No. 41340, 180 mm. long, obtained from Port Galera Bay, Mindoro Island, Philippine Islands, April 11, 1934. This is the second specimen taken of this genus and species.

FISH AND GAME ADMINISTRATION, MANILA, PHILIPPINE ISLANDS.

The Validity of *Phycodurus* Gill, a Genus of Syngnathid Fishes

By A. Fraser-Brunner

THE name *Phycodurus* was proposed by Gill (Proc. U. S. Nat. Mus., 18, 1895: 159) for a new genus of Syngnathidae based on *Phyllopteryx eques* Günther, which he considered to be generically distinct from *Phyllopteryx foliatus* Shaw. His account of the distinctions separating them, however, was very vague, and the name *Phycodurus* has since been almost universally considered a synonym of *Phyllopteryx*.



Diagrammatic sketches of *Phycodurus* (left) and *Phyllopteryx*, showing generic characters.
Fr. Cr., frontal crest; Med. sp., median annular spines; Med. lat. r., median lateral ridge; Up. caud. r., upper caudal ridge.

I have now had an opportunity of comparing the type of *P. eques* with examples of *P. foliatus,* in the British Museum (Natural History) and find ample justification for the generic separation of the two, and the consequent revival of the name *Phycodurus.*

The most important difference between the two lies in the arrangement of the lateral ridges. When it is considered that these are developed in direct relation to the vertebral structures it will be realised that they have a fundamental importance and must form a basic factor in the primary classification of syngnathids.

In *Phyllopteryx foliatus* the median lateral ridge becomes continuous with the *lower* caudal ridge, and the upper body ridge is discontinuous with the upper caudal ridge, which commences on the last two body rings and attains the dorsal profile behind the dorsal fin. In *Phycodurus eques* the median lateral ridge becomes continuous with the *upper* caudal ridge, behind the dorsal fin (see figure).

Phycodurus differs from *Phyllopteryx* also in the presence of a large frontal crest, the less compressed trunk region with its ventral profile expanded into three large prominences, and the presence of a median series of enlarged spines on the ventral surface. The character of the spines in the two forms is quite different, those of *P. eques* being thin and rather flexible, while those of *P. foliatus* are thick and strong and deeply serrated at the edges.

These are generic characters, of more importance than the number of osseous rings, or the position of the dorsal fin (which is dependent on the number of rings) or the number of dorsal rays. By a study of these characters some inkling may be obtained of the lines development has taken within the Syngnathidae.

In Duncker's system (Mitt. Nat. Mus., Hamburg, 29 (2), 1912: 219–240) *Haliichthys* Gray and *Phyllopteryx* (including *P. eques*) are placed together, but far removed from *Hippocampus* Raf. Later (*ibidem,* 32 (2), 1915: 9–120), *Haliichthys* is placed near *Hippocampus,* but *Phyllopteryx* retains its remote position. This arrangement while perhaps convenient for the determination of species, seems not to give a true idea of the relationships of the genera.

There seems little doubt that *Phycodurus* is derived from some form such as *Leptonotus* Kaup (from which perhaps *L. semistriatus, L. costatus* and others should be excluded) whereas *Phyllopteryx* is clearly derived from a fish like *Haliichthys,* and is not far removed from *Hippocampus.*

To sum up, it would appear that actually *Phyllopteryx foliatus* Shaw and *Phycodurus eques* (Günther) are derived from two distinct developmental lines, and their superficial resemblance indicates, not relationship, but an interesting case of parallelism due perhaps to similar environmental conditions.

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A Microscopic Study of the Pancreas in Fishes; Especially those of the Orders Haplomi and Cyprinodontes[1]

By Ephraim B. Boldyreff

THE existence of a relationship between the secretory function of the pancreas and pancreatic control of carbohydrate metabolism was demonstrated by the author in earlier publications and has been since confirmed by others: Boldyreff (1927, 1930, 1932, 1934), Coelho and Oliveria (1928), Okada, *et al.* (1928), Burge (1931). The wide variations in the amount and the distribution of glandular tissue, and the differences in arrangement of secretory cells in the pancreas of teleosts, as well as the variations in the structure of the gland as a whole in this group of vertebrates, offer an interesting field of study and may serve as a source of information concerning the relation of pancreatic structure to the functional activity of this organ.

These considerations served as a starting point for the present investigation. The final selection of *Esox, Umbra* and *Fundulus* was made at the suggestion of Prof. Carl L. Hubbs at the University of Michigan, who was interested in these studies from the phylogenetic point of view. *Esox* and *Umbra* are known to be closely related; these fishes are also known to be definitely carnivorous (Adams and Hankinson, 1928). The alleged relation of *Fundulus* to the pikes has never been firmly established and has recently been questioned by Hubbs and others (see below). According to Linton (1901), the alimentary canals of *Fundulus* are usually filled with vegetable matter; therefore it may be concluded that the animal is largely vegetarian.

Brunelli (1928) published an article dealing with the physiology and anatomy of the pancreas and liver in fishes. This author's contention was that there are two functionally different types of liver in fishes: (1) the hepatopancreas, present in those feeding on carbohydrate food (including mollusks), and containing large amounts of glycogen; (2) livers free from invasion by pancreatic tissue, which mainly store oil, and which are characteristic of carniverous fishes. Brunelli was inclined to believe that the presence of pancreatic tissue within the liver has a functional significance—the internal secretion of the pancreas may greatly facilitate the storage of glycogen. It is worthy of note, however, that the hepatopancreas organs of the fishes described in this report were found to be devoid of islet tissue.

Structure of the Pancreas in the Teleosts

The study of the structure of the pancreas in teleosts deserves attention not only because it reveals the degree of phylogenetic relationship of the animals studied, but also because it throws light on the relation of the pancreatic structure to the functional activity of the gland.

According to Laguesse (1889) the pancreas of teleosts presents many features peculiar to the embryonic tissue retained in the adult life: "Sous cette forme, le pancréas represente, comme concentration, un simple arrêt de dévelopment du pancréas des mammifères et des élasmobranches."

About sixty years ago M. S. Legouis (1870) and P. Legouis (1873) published their classical works on the structure of the pancreas in osseous fishes. They recognized three distinct types of pancreatic structure in the teleosts:

[1] Reported at the meeting of Michigan Academy of Science, Arts and Letters, Mar. 20, 1931.

(1) a compact pancreas, (2) a disseminated pancreas, (3) a pancreas of a diffuse type; they also stated that the pancreas of bony fishes is an active functioning gland and that "Les poissons osseux, comme tous les autres vertébrés, ont un pancréas en rapport avec leur mode d'organisation."

Robson and Cammidge (1907) discussed the purpose of pyloric appendages so common in teleosts and express the opinion that these organs have a function similar to that of the pancreas.

The fact that the pancreas of bony fishes is often of a disseminated or a diffuse type led some investigators to the erroneous conclusion that it is either poorly developed or even altogether absent: Kingsley (1912), Pratt (1925), Kyle (1926).

In spite of the excellent works dealing with the structure of the pancreas of teleosts published by Legouis (1870) and Legouis (1873), Laguesse (1889, 1893, 1894), Vincent and Thompson (1907), Stoehr (1893), and others, there is still a great deal of confusion and lack of understanding concerning this subject. For instance, Schaefer (1929), in his textbook of histology, referred to the islands of Langerhans as the "separate organs."

The nature of the Langerhans' islands and the peculiarities of the islet tissue of teleosts have received much attention: Vincent and Thompson (1907), Diamare (1899), Laguesse (1893), Rennie (1903, 1904), Jackson (1922), Bowie (1924), Bierry and Kollman (1928) and Hemmeter (1929). Laguesse (1893) observed that the islet tissue is much more abundant in the embryonic pancreas than in the developed organs and concluded that the acini may be formed from the islet as well as from the duct tissue. Vincent and Thompson (1907) and Bierry and Kollman (1928) reported the existence of transitory forms and indicated that one tissue may be transformed into another. The former authors stated: "Islets of Langerhans cannot be regarded as in any sense a tissue sui generis."

Rennie (1903, 1904) believed that the islets represent a group of entirely different type of cells: " 'principal islet'—ductless gland with internal secretory function."

Hemmeter (1929) stated in a recent publication that, "Although the greater part of the pancreas in Lophius (L. piscatorius) is contained within the liver, still the larger organs of Langerhans are as a rule surrounded by genuine pancreatic tissue . . . This pancreatic tissue is frequently overlooked" . . . and further, "these pancreatic fringes undoubtedly secrete pancreatic juice."

Gianelli and Giacomini (1896) expressed the opinion that islet tissue participates in the secretory work and secretes pancreatic juice. The intimate relation existing between the Langerhans' islands and pancreatic ducts has been observed by several investigators. Jackson (1922) reported a close association of the islet tissue and the ducts in the Elasmobranchs.

It is of some interest to note that according to McCormick (1924) "gross dissection fails to reveal islet tissue" in the pancreas of the herring, while "the zymogenous tissue is rather compact." Ukai (1928) also reported the lack of evidence of the islet tissue in the pancreas of two cartilaginous fishes. This author, as well as Bowie (1924) and Hemmeter (1929), referred to the occurrence of a hepatopancreas in fishes and to the existence of an inti-

mate relation between the islets and the general system of pancreatic ducts.

Methods Employed

Some of the fishes studied were caught in the lakes and streams in the vicinity of Battle Creek, Michigan. A number of preserved specimens were made available for this study through the courtesy of Prof. Carl L. Hubbs of the Museum of Zoology, University of Michigan.

The specimens for the microscopic work were always prepared in the same manner: first fixed in 10 per cent neutral formalin for 24 to 48 hours (sometimes longer), then transferred to 70 per cent alcohol, in which they were preserved. Care was taken to avoid postmortem changes by fixing the material as soon after obtaining it as possible (in most cases immediately). All tissues were imbedded in paraffin blocks. The following stains were employed: Mayer's, Heidenhain's, Weigert-Van Gieson's, methylene blue, and some others. The first three stains were used for the greater part of the work. In taking photomicrographs a yellow filter was employed when necessary and most of the pictures were taken with natural daylight illumination, while some were taken with the aid of an arc-light.

The Phylogenetic Relations of the Pancreas in Fishes

Fishes represent the most primitive and yet a well diversified group of vertebrates. It is generally recognized that in consequence the lowest members of this group (elasmobranchs, ganoids) retain the structural characteristics common to all vertebrates, while more highly organized fishes show considerable modification of the general anatomical plan. A definite compact pancreas is in all probability a primitive feature in the fishes. The modification and diffuseness of the structure of this organ in most fishes is a secondary feature, emphasizing the separate evolution of fishes as a distinct side-branch. The presence of an hepatopancreas in the primitive *Amia* on

TABLE 1. AN ABRIDGED CLASSIFICATION OF THE FISHES STUDIED[2]

Superorder	*Order*	*Family*	*Genus*	*Subgenus*	*Species*
Holostei	Cycloganoidea	Amiidae	*Amia*	———	*calva*
Teleostei	Haplomi	Umbridae	*Umbra*		*limi*
		Esocidae	*Esox*	(*Kenoza*)	*americanus*
					vermiculatus
					niger
				(*Esox*)	*lucius*
				(*Mascalongus*)	*m. masquinongy*
					m. immaculatus
	Cyprinodontes	Cyprinodontidae	*Fundulus*	———	*heteroclitus*
					majalis
	Percomorphi	Percidae	*Perca*	———	*flavescens*

the one hand and in the higher teleosts on the other hand may be explained by assuming, either that the hepatopancreas in the two groups is of indipendent origin, or that the teleosts are polyphyletic, having arisen from separate ganoid stocks along at least two lines, one with a definite distinct organ, as *Acipenser* and *Esox,* the other with a more diffuse organ pene-

[2] Table prepared by Dr. Carl L. Hubbs.

trating the liver as in *Amia* and *Fundulus*. The differences found between the structure of the pancreas in *Fundulus* and in *Esox* and its relatives, seem to confirm the modern view that these genera and the groups they represent are not, as formerly believed, closely related. The group Cyprinodontes (or Microcyprini), containing *Fundulus,* is held by recent ichthyologists (Regan, 1911; Hubbs, 1924), to be quite distinct from and less primitive than the Haplomi—*Esox, Umbra,* and certain fishes related to them. A brief classification of the fishes under consideration is given in the above Table 1.

Amia calva

Fig. 10

There are several reports of observations on the pancreas of the fresh water dog-fish: Macallum (1886), Piper (1902), McCormick (1924).

According to Macallum (1886) the pancreas in this fish is of a disseminated type. A part of the gland is found adherent to the extreme anterior end of the mid-gut, the greater part enveloping the larger branches of the portal vein in the interior of the liver, extending through this organ from one lobe to another like a bridge.

McCormick (1924) described the pancreas in *Acipenser rubicundus* (= *A. fulvescens*) and *Amia calva* in the following manner: in the former the pancreas is represented by a "heavy band surrounding the portal vessels, and extending to, but not invading, the substance of the liver." The islets are reported to be of an irregular shape. In *Amia calva* he described the pancreas as—"somewhat more diffuse than in the preceding," and free from "principal" islands.

In view of this discrepancy in the reports of the authors mentioned, and because of the fact, that while not closely related to the pikes, *Amia calva* is an even more primitive member of the group Pisces, the author has included this fish in his studies.

The data obtained confirm the findings reported by Macallum (1886). A compact mass of pancreatic tissue is located on the small intestine attached to the intestinal wall between the pylorus and the spleen. In this part of the gland many areas appear resembling islands of Langerhans. Most of these areas are fairly large, usually oval or rather oblong in form and not distinctly separated from the acini by a marked boundary line. The rest of the pancreatic tissue is distributed throughout the liver following the branches of the portal vein to which it is attached. Many pancreatic ducts are present and the secretory acini are quite abundant.

Piper (1902) gave a detailed account of the embryonic development of the pancreas of *Amia calva*. He described also the formation of pancreatic ducts and stated that in the liver they are numerous and independent of the excretory ducts of the liver. These observations are in full accord with the writer's own findings.

Umbra limi

In *Umbra* the glandular tissue is found attached to the blood vessels and also free in the mesentery fat. Most of the pancreas is located immediately below the stomach. This part of the pancreas is compact and may even be found macroscopically. The liver is free from pancreatic tissue. This fact

is quite noteworthy, because in *Fundulus* pancreatic cells penetrate deeply into the tissues of the hepatic lobes, while in the pikes the pancreas extends only to the surface of the liver without invading it (Brunelli, 1928; Boldyreff, 1931). The islands of Langerhans are of varied size, not very prominent, and few.

Esox americanus

Fig. 4

The pancreas of *Esox americanus* closely resembles that of *Esox vermiculatus* and *E. lucius,* but the gland is larger and more compact than in the former. The islands are well defined and oval in form. The "principal" islets were not observed.

Esox vermiculatus

Figs. 3, 5, 7

The location of the pancreas in this species is about the same as in the muskellunge and the pike. The glandular tissue extends from the hepatic lobes in the vicinity of the bile duct, to the spleen. It is, however, not quite as compact as in the muskellunge and pike and could be located macroscopically only with some difficulty.

Some patches of pancreatic tissue are distributed in the mesentery fat. The ducts are relatively large in proportion to the size of the pancreas. The splenic end of the pancreas has a characteristic form and contains islet tissue. The islands are of two types: (1) intrapancreatic, and (2) "principal" islets. The latter type is occasionally found in the mesentery fat near the spleen and a single islet may attain the size of a pin-head.

Lobes of the pancreas entirely free from islet tissue are also present. Some islands of Langerhans are separated from the pancreatic parenchyma by a very thin layer of connective tissue. The islands are oval or round and of a varied size. There are some structural variations in the pancreas of *Esox vermiculatus* due to individual anatomical differences.

Esox niger

The type and structure of the pancreas in this fish resemble those of *Esox vermiculatus,* except that pancreatic tissue appears to be less compact. The gland contains regularly round and uniformly small islands of Langerhans. No "principal" islets were observed.

Esox lucius

Figs. 1 and 11

In the pike the pancreas is a well defined and compact gland located on the small intestine (Fig. 11). The anatomical position of the pancreas in *Esox lucius* is very similar to that of the muskellunge. The hepatic end is formed by two lobes, lying just below the gall-bladder and encircling the bile duct. The body of the gland is attached to the gut and extends from the liver to the pyloric valve, where it terminates at the spleen. The organ is of considerable size. There seems to be, however, a certain degree of individual variation in its shape and size. It has a uniform structure and is composed mostly of secretory acini [3].

[3] The pancreas of the pike has been described in more or less detail by European investigators. But there is still a question as to whether or not the American pike is specifically identical with the European species.

The continuity of pancreatic parenchyma is interrupted to some extent by the presence of fat which is found in the interlobular spaces as well as in the zymogenous tissue. The islands of Langerhans are not very numerous, and some parts of the glands are entirely free from the islet tissue. Most of the islands are round or oval and are fairly large. Some of the Langerhans' islands are of irregular form and are similar to the islands occurring in the pancreas of muskellunge. The islands of the splenic end are round or oval and resemble those found in *Esox vermiculatus*. The pancreatic ducts are quite prominent and may be easily found. The body of the organ is traversed by numerous nerve trunks and blood vessels. A sheath of connective tissue covers the gland.

The existence of a close relation of the islet tissue to the pancreatic ducts has already been referred to: Laguesse (1894), Jackson (1922), Ukai (1926). It is quite apparent that the pancreas in this fish is an important secretory gland.

Esox masquinongy masquinongy

Figs. 2 and 6

The pancreas in the muskellunge is situated along the small intestine, and extends from the liver toward the spleen. The gland is well developed and large; it is easily found and may be readily recognized macroscopically. The continuity of the glandular cells is somewhat interrupted by patches of fat which invade the organ and are located between its lobes as well as within them, penetrating into zymogenous tissue to some extent. The ducts are large.

Two types of islets are present: (1) well defined round islands of a uniformly small size, and (2) islands of irregular shape and varied size. The peculiar irregular shape of the islands in the muskellunge was reported by McCormick (1924).

The invasion of the "principal" islands by acini is known to take place in teleosts and has been previously described. The reverse structural relation between acini and islets was found by the author to occur in this fish (and in the pike): groups of cells of zymogenous tissue were found within a giant Langerhans' island of the intrapancreatic type. In general, islet tissue is not very abundant.

Esox masquinongy immaculatus

The structure of the pancreas in this subspecies of muskellunge is quite similar to that of the preceding. Some structural differences, however, were observed: (1) the pancreatic tissue seems to extend deeper into the interlobular hepatic spaces, but it terminates at the surface of the hepatic lobes and does not penetrate into the tissues of the liver; (2) the islands are of a uniformly small size and are round or slightly oval in form, resembling the islands observed in the pancreas of *Esox vermiculatus, E. americanus* and *E. niger*.

Fundulus majalis

In *Fundulus* the pancreas is of a diffuse nature, yet due to a wide distribution the pancreatic tissue is by no means deficient in quantity. On the other hand no typical islands of Langerhans are present. The zymogenous tissue is found attached to the mesenteric blood vessels and also free in the

mesentery fat, extending from the liver to the spleen. The pancreas invades the liver with the branches of the portal vein to form hepatopancreas.

Fundulus heteroclitus

Fig. 8

In this species of *Fundulus* the pancreas is quite similar in structure to the pancreas of *Fundulus majalis*. The pancreatic tissue, however, is more abundant. In the specimens examined no islet tissue was found.

Perca flavescens

Fig. 9

It is a common belief that the perch has no pancreas; statements to that effect are frequent, even in textbooks of comparative anatomy (for instance, Pratt, 1925). Careful investigations, however, have shown the fallacy of this view (McCormick, 1924).

The general type of structure of the gland in *Perca flavescens* resembles that of other teleosts: pancreatic tissue is distributed in the mesentery fat, attached to the blood vessels. It seems probable that differences in the structure of the pancreas of the perch may sometimes be observed, due either to individual variations or to anatomical anomaly. The islands of Langerhans are small, few and uniformly round.

Summary and Conclusions

1. The microscopic structure of the pancreas in the following fishes is described: *Amia calva, Umbra limi,* six kinds of pike (*Esox*), *Fundulus heteroclitus, Fundulus majalis* and *Perca.*

2. A great degree of similarity in general anatomic plan was found in *Esox* and *Umbra*, particularly in the pikes of the Subgenus *Kenoza.*

3. Three very different types of pancreatic structure were found: (1) a compact, well defined, rather large and distinctly independent organ in *Esox* and *Umbra*; (2) an hepatopancreas, consisting of diffuse pancreatic tissue, largely within the liver, in *Fundulus* and in *Amia calva,* and (3) diffuse pancreatic tissue not extending into the liver, in *Perca.*

4. Extrapancreatic islet tissue, forming the so-called "principal" islands of *Esox vermiculatus*, probably bears the same relation to the pancreas proper of this fish as the aberrant pancreas does to the main pancreas in mammals, *i.e.*, it represents the remnants of the embryonic glandular structure.

5. In most of the fishes studied the pancreatic ducts are well developed.

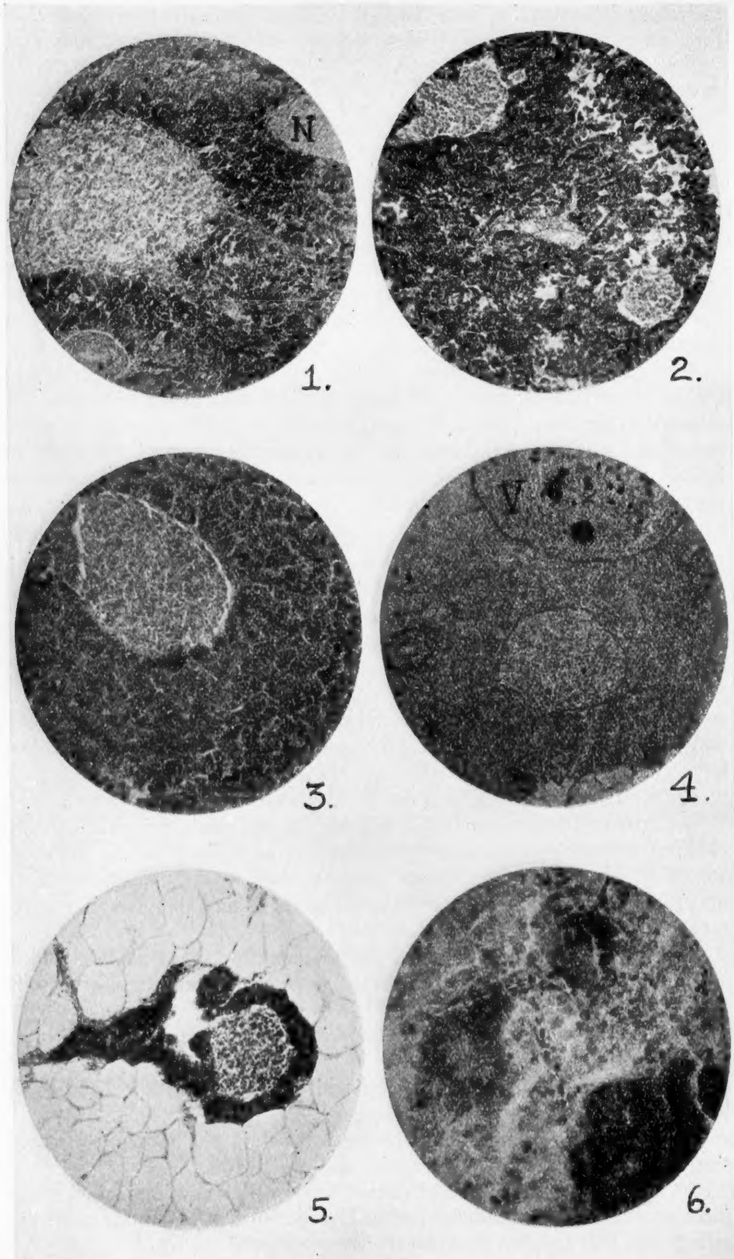
6. Islands of Langerhans appear to be relatively larger and scarcer in fishes than in man and dog.

7. Giant intralobular islands of Langerhans were found in the pancreas of the muskellunge.

8. Secretory alveoli are frequently found within the islands of Langerhans in the pancreas of pike and muskellunge.

9. No islands of Langerhans were observed in the diffuse pancreatic tissue and hepatopancreas of *Fundulus* and *Amia calva.*

10. If pancreatic tissue found within the liver possesses internal secretory function which aids in the formation of glycogen in that organ, the cells concerned with this activity would be the secretory acini.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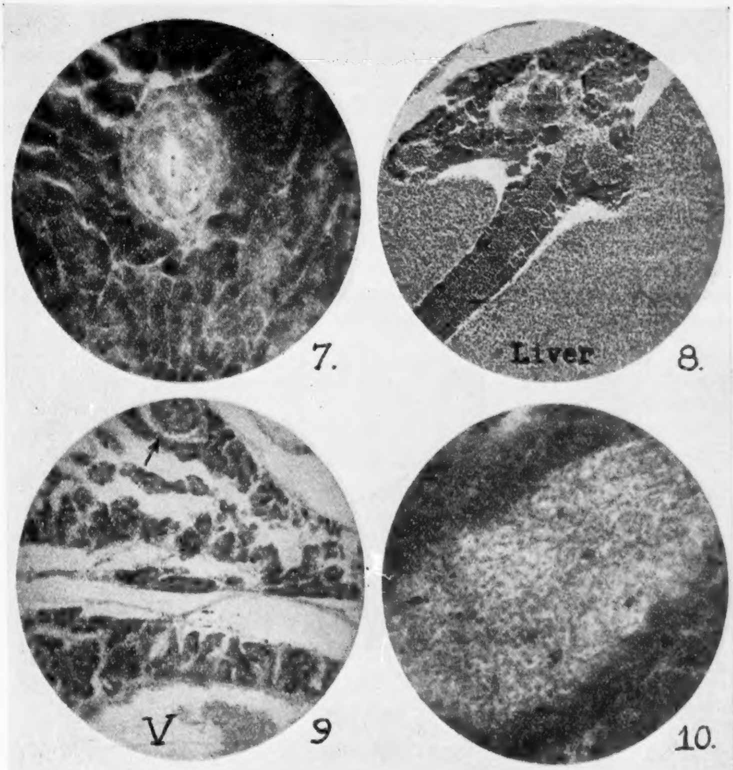

Explanation for Figs. 1—10

Photomicrographs of Teleost Pancreas

Fig. 1. *Esox lucius* (body of the gland). Acini, island of Langerhans, secretory duct, blood vessel, and N—a nerve trunk. ×75, Weigert-Van Gieson stain.

Fig. 2. *Esox masquinongy masquinongy* (body of the gland). Acini and two islands. ×120. This and all following sections were stained by Mayer's method.

Fig. 3. *Esox vermiculatus* (splenic part). Acini and island of Langerhans. ×200.

Fig. 4. *Esox americanus* (splenic part). Acini, island of Langerhans, secretory ducts, and V—a vein. ×150.

Fig. 5. *Esox vermiculatus*. "Principal island" in mesentery fat near the spleen. ×150.

Fig. 6. *Esox masquinongy masquinongy* (splenic part). Acini within the island of Langerhans. ×400.

Fig. 7. *Esox vermiculatus* (body of the gland). Secretory acini and intralobular duct. ×300.

Fig. 8. *Fundulus heteroclitus* (Hepatopancreas). ×50.

Fig. 9. *Perca flavescens*. Island of Langerhans, indicated by arrow, secretory acini; and V—a vein. ×70.

Fig. 10. *Amia calva* (splenic part of the gland). Lightly staining area resembling the island of Langerhans. ×200.

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The author wishes to express his gratitude to all persons who rendered kind help during the progress of this work. He feels especially indebted to the following: the late Dr. A. A. Maximow, Professor of Anatomy, University of Chicago, for experienced advice and valuable instructions in histological technique; Dr. Carl L. Hubbs, Curator of Fishes, University of Michigan, for the supply of material and interest in the work; Dr. Peter Okkelberg, Professor of Histology and Embryology, of the same University, for helpful criticism; Mr. LeRoy J. Smith, Technical Assistant in Anatomy, University of Michigan, and Mr. E. W. Roberts of Battle Creek, Michigan, for assistance in microscopic work; and Margaret E. Grange Boldyreff for helping in the preparation of the manuscript.

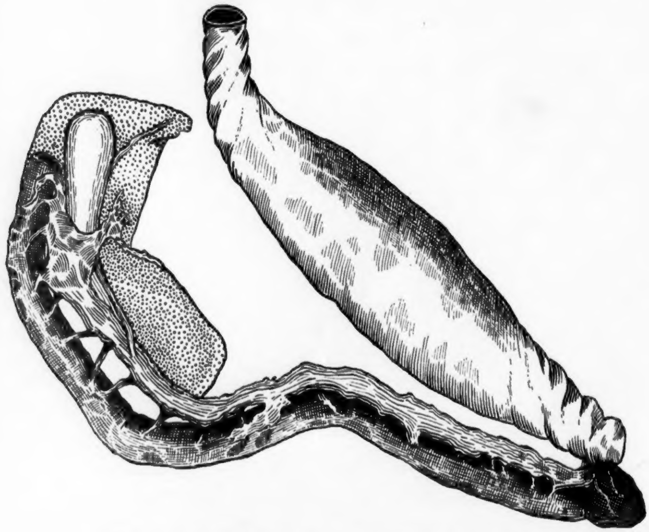

Fig. 11. General view of the pancreas in the pike.
The gland is located between the stomach and the intestine, extending from the pylorus, at the spleen, to the liver, ending near the gall-bladder. Drawn from nature; 0.3 actual size.

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Some Undescribed Young of the Pointed-Tailed Ocean Sunfish, *Masturus lanceolatus*

By E. W. Gudger

IN the course of extensive studies of the history and distribution of *Masturus,* and of the structure of its tail, it was found that there are two undescribed young fish in the Museum of Comparative Zoology at Cambridge, Massachusetts, and three others in the United States National Museum at Washington. All are catalogued as *Orthagoriscus mola.* Through the courtesy of the officials of these institutions, I have been permitted to study these fish and to have drawings made of two of them. The results of my investigations are herewith presented.

Description of a 53-mm *Masturus* in the Museum of Comparative Zoology

In October, 1880, the "Blake" expedition took two young sunfishes of about the same size from the stomach of a dolphin (*Coryphaena*) in Lat. 31° 30′ N, and Long. 73° 30′ W. (i.e., in the western part of the Sargasso Sea). One is so mounted that it cannot be loaned, but the other is before me (Fig. 1). Its measurements are: length to end of body 53 mm. (2.1 in.), to tip of filament about 65 mm. (2.5 in.); depth behind eye 37 mm. (1.4 in.), in front of dorsal and anal 30 mm. (1.2 in.). The fin-ray count is: pectoral, 9; dorsal, 21; caudal, 18 (5 above, 4 in center, 9 below); anal 20. The D. + C. + A. combination is 59.

This is undoubtedly a young *Masturus lanceolatus,* and certain of its structures deserve study. The little fish is wedge-shaped either in a vertical or a horizontal plane. It is thickest on the upper edge just back of the eyes where there is a serrated ridge in the middle section. Below the abdominal cavity there is a thin transparent region about 5 mm. wide, apparently made of skin only, separate from the abdomen, and ending in a serrate keel. This is no thicker than light cardboard. The only student of the young *Masturus* who has recognized this keel-like structure is Putnam (1871). He had four specimens from Massachusetts Bay, each about 2 in. long, and of them he says as to this structure that: "Along the ventral portion of these young fishes is a fleshy ridge, easily detached [?] from the body, and armed with several rows of small spines. The back, for about half the distance in front of the dorsal fin, has a slightly raised fleshy ridge." Both these structures are fairly well shown in Putnam's Figure 3, also in my Figure 1.

The skin is everywhere rough to the touch, and on the dorsal and ventral ridges thick-set with minute prickles. Those below are the larger and give the ventral edge a serrate appearance. On the edges are scars (4 above and 3 below) left where the large median spines (found in the post-larval stage) have fallen off. On the side of the body are the scars of the 7 large lateral spines. For all spine scars see Fig. 1. These scars, like the spines of the earlier stage, are diagnostic characters for the young *Masturus.*

On various parts of the body, principally below the eyes, on the abdomen, at the base of the anal, and under the pectoral fins are remains of a silvery coloring matter, which apparently once covered the sides of the little fish. The lower sides and venter are very light in color as Fig. 1 shows. The dorsum is dark brown, the color deepening as the mid-dorsal surface is reached.

The rear end of the body is definitely marked off from the caudal fin. This is more or less transparent and the bases of the fin rays can be traced clear to the body. The membrane is divided into two areas. The outer is thin and without color, and of no appreciable thickness. The inner zone is possibly two or three times thicker than the outer, and thicker at its dorsal than at its anal termination. The caudal filament, which starts above the median line, is composed of four rays which seem to fray out into a number of fine thread-like bodies, such as Collett (1896) noted in the pointed end of the caudal lobe of the Prince of Monaco's adult specimen. There is in the hinder part of the body on either side, anterior to and in line with the base of the filament a faint thickening which looks as though it might be the hinder part of the spinal column.

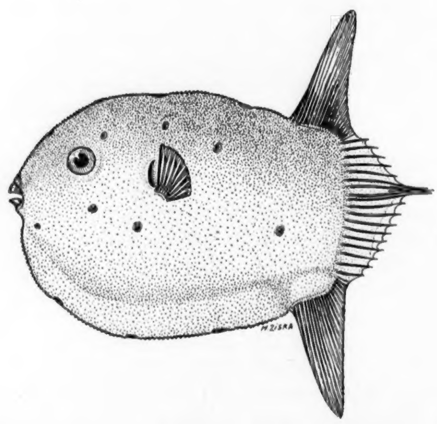

Fig. 1.—A young *Masturus lanceolatus* (x 1) taken from the stomach of a *Coryphaena* in the western Sargasso Sea in 1880. Museum of Comparative Zoology, No. 24875.

Description of a 47-mm *Masturus* in the U. S. National Museum

My other material consists of the three young fish taken off Greytown, Nicaragua, in 1869. After 65 years in alcohol, they are in bad condition. They are uniformly dark brown in color, the fins have suffered much—the outer parts of dorsals and anals being gone. Fin ray counts are difficult, but

careful examination has finally brought counts that are dependable. The general data for these three fish are found in the accompanying table.

No.	Length		Depth		Fin Ray Count				D.+C.+A. Combination
	Standard	To Tip Caudal	Behind Eye	Before D. & A.	P	D	C	A	
1	43 mm. 1.7 in.	47 mm. 1.9 in.	33 mm. 1.3 in.	26 mm. 1 in.	9	*c.*18	7+4+10	17	56
2	47 mm. 1.9 in.	58 mm. 2.3 in.	35 mm. 1.4 in.	29 mm. 1.2 in.	9	15	9+4+12	*c.*16	56
3	60 mm. 2.4 in.	70 mm. 2.75 in.	39 mm. 1.5 in.	33 mm. 1.3 in.	10	17	8+4+10	16	55

Like the Museum of Comparative Zoology specimen, these fish are thick above, especially over the eye, and thin out wedge-fashion either ventrad or caudad. On the dorsum is a low serrate elevation. Below the belly proper is a thin serrate keel, apparent to the touch but, because of the uniform coloration, not so much to the eye as in the Harvard fish. The two smaller fish have the characteristic spine scars on dorsum, venter, and sides. These may be seen in Fig. 2, and on the venter may be seen the remains of one such spine. On the 70 mm. fish the scars are indistinct.

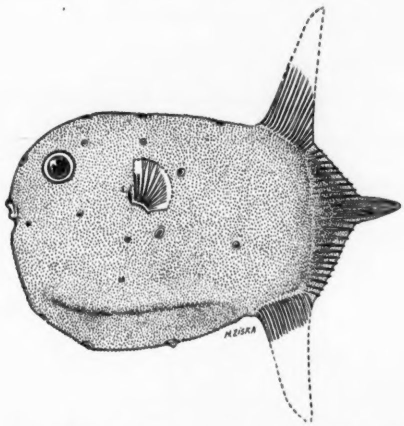

FIG. 2.—A young pointed-tailed ocean sunfish (natural size) collected off Greytown, Nicaragua, in 1869. United States National Museum, No. 5704.

On each of these fishes the remains of a silvery colored layer is most abundant between and below eye and pectoral fin and on the ventral keel. In life this must have covered the whole body. It is to be regretted that there is no description of the live or just captured little fish.

The caudal structures in these three fish are all alike and of particular interest in this research. They are all different from that of the Museum of Comparative Zoology specimen. The caudals are all thick in texture and

dark in color. As Fig. 2 shows, the tail fin is definitely marked off from the body by a band-like structure in the skin, but in thickness the tapering of the body caudad is unbroken to the very edge of the fin. The inner section of the caudal is thick and somewhat fleshy, while the outer part is thinner and somewhat transparent. If the tail is held up before a strong light the spines can be traced to the band above referred to, but if looked down on in ordinary fashion only the outer parts are visible. Body and fin seem to be continuous in gross structure.

The caudal filament of each fish starts above the median line of the body. In No. 1 it has been broken off, but by holding the stump before a strong light there are seen two outside rays and between these are two broader ray-like structures which seem to be fibrous in make-up. Specimen No. 2 has the filament produced as shown in Fig. 2. It too has this composed of two outer and two inner rays. These latter are separated at the base but their outer ends seem to spread out each into a little brush. The largest fish (No. 3) shows the same structure. The two outer rays are quite distinct, the two inner ones are distinct at the base but soon converge and have their outer ends frayed out into many fibers like the hairs in an artist's brush. However, this filament instead of being pointed at the outer end as is that of No. 2 shown in Fig. 2, is decidedly spatulate.

The structure of the caudal filament in these little fish will help to an understanding of the structure of this organ in the adult—a study now under way.

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1871 On the young of *Orthagoriscus mola*. *Proc. Amer. Soc. Adv. Sci. for 1870*, 19. meet.: 255–260, 4 figs.; *Amer. Nat.*, 4, 1931: 629–633, 4 figs.

American Museum of Natural History, New York City.

Ichthyological Notes

RECORDS OF FISHES RARELY CAUGHT IN SHRIMP TRAWLS IN LOUISIANA[1].—The records included here seem to the writer to be of interest as indicative of the comparative abundance of some of the rarer fishes in the territory studied. From July, 1931, to June, 1933, regular trawling operations were carried on for the cooperative Shrimp Investigations of the U. S. Bureau of Fisheries and the Louisiana Department of Conservation in Barataria Bay and the adjacent Gulf of Mexico, which is representative of the Louisiana coast. Since that time, the work has been done by Mr. John C. Pearson, of the Bureau of Fisheries, to whom the writer is deeply indebted for all data collected from July until December, 1933. Therefore, the records cover a period of two and one-half years. The regular otter trawl was used, varying in wing-spread from 25 to 50 feet, with mesh measuring one and one-half inches stretched. In the 423 hauls made, 144,000 fish were taken.

Graphs of abundance of the more common species showing seasonal changes have been made and will be published later. Of the 85 species caught, the records of 30 comprised only 0.09 percent of the total numbers. Because of their rarity, it has been found desirable to treat them separately.

The trawl is well adapted to catch small, slow-moving bottom fishes. Yet these records cannot be taken at their face value as indicative of absolute abundance without consideration of other factors. The chief one seems to be habitat. Since the trawl of necessity must be in at least four feet of water, thus usually at a considerable distance from the gradual sloping shore, the shore fishes were caught rarely or not at all. *Pogonias cromis* and *Opsanus tau* though quite common were not taken. Likewise *Archosargus probatocephalus, Mugil cephalus, Menidia peninsulae* and *Syrictes louisianae* were taken rarely, although they were quite common in seine hauls.

It is significant that of the 10 specimens of *Archosargus probatocephalus, Anguilla rostrata, Mugil cephalus* and *Menidia peninsulae* taken from July, 1931, to June, 1933, six were caught in two hauls during a cold spell in December, 1932. The cold had probably forced these fish into deeper water, but may also have slowed their activities; in either event making them more susceptible to capture.

The other fishes listed seem to be in the category of truly rare.

Following are the catch records:

Pristis pectinatus Latham.—One fish was caught in upper Barataria Bay, October, 1933.

Pteroplatea micrura (Schneider).—This ray was taken once in Barataria Bay in June, 1932, and once 3 miles out in the Gulf in September, 1932.

Stoasodon narinari (Euphrasen).—One of these rays, caught in upper Barataria Bay in August, 1931, was estimated to weigh 300 or 400 pounds. A small one was taken in the bay in August, 1933, and another was caught 2 miles offshore in the Gulf in April, 1933.

Elops saurus Linnaeus.—One specimen was taken in upper Barataria Bay, August, 1933.

Anguilla rostrata (Le Sueur).—One individual was caught at the upper end of Barataria Bay in December, 1932.

Myrophis punctatus Lütken.—One specimen was taken at the upper end of Barataria Bay in 1932.

Hippocampus regulus Ginsburg.—One specimen was caught in the lower end of Barataria Bay in March, 1933.

Syrictes louisianae (Günther).—Five specimens were taken, 2 in Barataria Bay in March, 1932, and April, 1933; 2 in April, 1932, and 1 in June, 1932, 1 mile out in the Gulf.

Menidia peninsulae (Goode and Bean).—Five of this species were secured in four hauls in the cooler months of October, November and December, 1932, in Barataria Bay. It was commonly taken with seines in shallow water and seemed to remain close to the shore except at night, when it was sometimes caught in plankton hauls 3 or 4 miles offshore.

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[1] Published by permission of the United States Commissioner of Fisheries.

Mugil cephalus Linnaeus.—This species was quite common and often used as food, but it remained so close to shore that only 11 individuals were taken, all from the upper end of Barataria Bay. Two were taken in 2 consecutive hauls in December, 1932, 7 in 4 hauls in September, 1933, and 1 each in October and December, 1933.

Sphyraena guachancho Cuvier and Valenciennes.—One fish was taken in East Bay in October, 1931, 2 more were taken in August, 1933, and 2 in November, 1933.

Xurel lata (Agassiz).—One fish was taken in the Gulf, 3 miles offshore, in July, 1932, and another 12 miles offshore in September, 1933. In Barataria Bay 1 was taken in July, 1933, and 2 in 1 haul during August, 1933.

Paratractos chrysos (Mitchill).—This fish was taken once in October, 1932, and once in April, 1933, one mile out in the Gulf. They were within the bell of the jellyfish, *Stomolophus*.

Seriola sp.—Fourteen specimens were taken in 1 haul 1 mile out in the Gulf in July, 1933, and 6 more were taken in another haul at the lower end of Barataria Bay in the same month.

Trachinotus falcatus (Linnaeus).—One fish was taken 1 mile offshore in East Bay in September, 1933.

Epinephelus drummond-hayi Goode and Bean.—One small specimen was taken 3 miles offshore in the Gulf of Mexico, October, 1932.

Diplectrum formosum (Linnaeus).—One of this species was taken one-half mile offshore in West Bay during August, 1933; another was caught in upper Barataria Bay in September, 1933.

Lobotes surinamensis (Bloch).—One individual was taken in Barataria Bay in September, 1933.

Lutianus blackfordii Goode and Bean.—Fishermen state that this fish never comes in closer to the shore than 15 miles, but the writer has taken it on 2 occasions nearer than this, once in July, 1931, 12 miles offshore, and once in July, 1932, within 4 miles of the beach. Another was taken by Mr. John C. Pearson 2.5 miles offshore in East Bay in August, 1933.

Brachygenus chrysargyreus (Günther).—Four specimens were taken in 1 haul 4 miles out in the Gulf in July, 1931.

Archosargus probatocephalus (Walbaum).—This species stays around pilings and sunken boats, rarely venturing into open water. It was taken once in December, 1932, and once in May, 1933, both times in the upper end of Barataria Bay. Two more were taken by Mr. Pearson one-half mile offshore in East Bay during November, 1933.

Gobiesox virgatulus Jordan and Gilbert.—This clingfish was caught once in January and once in March of 1933 in the lower end of Barataria Bay.

Balistes capriscus Gmelin.—The triggerfish was caught three times in the following localities: 3 miles offshore in the Gulf, October, 1932; 8 miles offshore in August, 1933; and 12 miles offshore in December, 1933.

Monacanthus hispidus (Linnaeus).—This filefish was taken once, 3 miles offshore in the Gulf during May, 1932.

Rhinesomus triqueter (Linnaeus).—The trunk fish was taken once, 3 miles offshore offshore in the Gulf during May, 1932.

Echeneis naucrates (Linnaeus).—This remora was taken once during August, 1933, one-fourth mile from shore in East Bay.

Dormitator maculatus (Bloch).—One specimen was caught in the upper end of Barataria Bay during the fall of 1932.

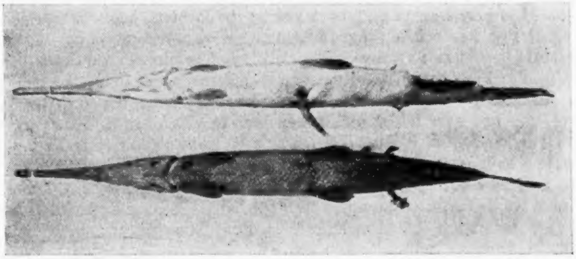
Ophidion, sp.—One fish was caught one-fourth mile from shore in West Bay, August, 1933.

Antennarius, sp.—Sixteen specimens of this little frog-fish were caught, as follows: one in January and 3 in 3 hauls during March, 1933, in Barataria Bay; 4 times each in 2 hauls in March and 1 in April, 1933, the first being 1 mile offshore in the Gulf and the last 2 being 3 to 6 miles offshore.

Ogcocephalus radiatus (Mitchill).—This species was taken once, 3 miles out in the Gulf in March, 1933, and again in April, 1933, 1 mile offshore.—GORDON GUNTER, *Natchitoches, Louisiana (Formerly, United States Bureau of Fisheries, New Orleans, Louisiana).*

IDENTIFICATION OF *TRACHINOIDES MAROCCANUS* AND *TRACHINOTUS MADEIRENSIS*, BORODIN, 1934.—In a recent paper dealing with the fishes obtained during the cruise of the Yacht *Alva* to the Mediterranean in 1933, Dr. N. A. Borodin has described a new genus and species of Trachinidae, named *Trachinoides maroccanus* (Bull. Vanderbilt Mar. Mus., 1 (4), 1934: 119, pl. 2, fig. 2, 3). I have not examined the unique holotype, taken off the coast of Morocco, but from his description and figures there can be little doubt that the fish is a young Hake—*Merluccius merluccius* (Linnaeus). In the same paper (p. 111, pl. 1, fig. 1) he describes and figures a new species of *Trachinotus* from Madeira, which he names *T. madeirensis*. This would appear to be identical with *T. glaucus* (Linnaeus). The Linnaean species was included by Günther (Cat. Fish., 2, 1860: 477) in the genus *Lichia*, but its correct position has been pointed out by Regan (Ann. and Mag. Nat. Hist., 7 (12), 1903: 349).—J. R. NORMAN, *British Museum (Natural History), Cromwell Road, London SW 7, England.*

A CASE OF MELANISM IN *LEPISOSTEUS OSSEUS*.—During April 1933, while gigging gars in Lake Harris, Lake County, Florida, a melanistic specimen was picked up. It was the common long-nosed gar, *Lepisosteus osseus*. At first it was thought that it might be covered with some foreign substance but a vigorous washing and closer examination showed the coloring to be in the specimen itself. Since the writer had never seen a gar that approached this one in color a picture was taken of the specimen beside a normally colored individual. This picture brings out fairly well the degree of darkness in comparison with the normal.



The writer does not happen to know of any other reports of melanism for this species.—C. C. GOFF, *Leesburg Experimental Station Laboratory, Leesburg, Florida.*

Herpetological Notes

NOTES ON THE SNAKES OF LEEDS AND FRONTENAC COUNTIES, ONTARIO.—Eastern Ontario has a rich and varied fauna and it is surprising to find how little has been published on its animal life. The snakes, in particular, have been almost entirely neglected. With a few exceptions, Lindsay (1931), Toner (1934), there is almost a total lack of literature relating to Leeds and Frontenac. Since there is no list of the species occurring here the writer is bringing together his own records and such others as he could get, intending this paper to be a contribution towards a complete vertebrate fauna of Ontario if such is ever written. In any case such notes should be published if only for the information of other workers in the same field.

The area in which the writer has been interested centers on Kingston and the main collecting has been east and north along the Rideau canal; east as far as Brockville along the St. Lawrence River; west and north along the upper waters of the Napanee River system and east around the lakes near Charleston. This region contains many lakes and much wild, rocky country. Towards the east and north the underlying rock is igneous and metamorphic while around Kingston it is sedimentary limestone. In places there are rock falls and talus slopes, as on the southwest shore of Gananoque Lake. Very little of the original forest remains though large areas are covered with thick second growth. There are not many bogs but cedar swamps are quite numerous though seldom of large size.

Most people living in this region regard all snakes as poisonous and try to kill every one they see. It is very rare to find, even among the farmers, one who protects or looks on these reptiles as beneficial. Why all snakes are regarded as poisonous is rather a mystery as there should be no dangerous snakes found anywhere near here. Nash (1908) says that *Crotalus horridus* at one time was distributed throughout the province. The writer has made enquiries about rattlesnakes everywhere he has collected and could find no one who had ever heard of, or seen, one in this district. However, when the copperhead, *Agkistrodon m. mokasen,* is mentioned, many people state that it is present and one or two have given a good description of this snake. It may have been present at one time and may yet be taken in Leeds County. As an example, the abundance of the black pilot snake in this region was unsuspected for a long time. It is only within the past five years that it has been known to occur in numbers anywhere in Ontario. Perhaps further intensive collecting will prove or disprove the existence of copperheads in these counties.

The writer has never seen the fox snake, *Elaphe vulpina,* in this region but has been told of a large brown snake found in the rocky hills that may be this species.

The writer wishes to thank Mr. R. O. Merriman, of Kingston, who stimulated his interest in snakes and gave him much information and advice on the handling and care of captive specimens. He also wishes to thank Mr. E. B. S. Logier, of the Royal Ontario Museum of Zoology, for verifying many identifications.

List of Species

1. *Diadophis punctatus edwardsii* (Merrem).—The ring neck is the rarest snake of the region: only one specimen was collected. This was from Pittsferry on No. 2 Highway. It escaped before it could be thoroughly examined.

2. *Liopeltis vernalis* (Harlan).—The smooth green snake is common in grassy meadows. Noted at Washburn, Gananoque Lake, Sunbury, and other places. This is a gentle and easily tamed species.

3. *Elaphe obsoleta obsoleta* (Say).—Lindsay (1931) summarized the records for Ontario, to which I have added others (Toner, 1934). The pilot black snake is common in the rocky lands of Leeds County and has several times been noted on the islands of the St. Lawrence River. A number of specimens were taken during 1934. Two live ones from Gananoque Lake were sent to Mr. Logier. There is a small area near this lake which has never been burnt or cut over, with a talus slope close to the water that makes an ideal wintering den. Farmers of the vicinity have told me that they have seen as many as 15 or 20 black snakes in the spring, sunning themselves near this talus slope.

4. *Lampropeltis triangulum triangulum* (Lacépède).—The milk snake is the most abundant of the larger snakes and is found everywhere in the region. Specimens were collected from Knowlton Lake, Kingston, Brewer's Mills, Grippen Lake, and Black Rapids. Many others were noted in various localities.

5. *Natrix sipedon sipedon* (Linné).—The water snake is found in every stream and lake of both counties. It varies considerably in color and markings. A large number of these snakes were seen at Marble Rock on the Gananoque River. They are very numerous in Collins Creek, about three miles north of Collins Bay.

6. *Storeria dekayi* (Holbrook).—Dekay's brown snake is common but very seldom seen. Several specimens were taken within a few miles of Gananoque during 1934. One specimen was captured on Hay Island, in the St. Lawrence.

7. *Storeria occipito-maculata* (Storer).—The red-bellied snake is not as common as the preceding species. It was taken at Black Rapids on the road, and at Sunbury under flat limestone rocks on a hillside.

8. *Thamnophis sauritus sauritus* (Linné).—The ribbon snake was taken at Cross Lake, Arden, and no doubt with further collecting will be found in this region. Captive specimens fed on chopped fish or live frogs but refused beef, earthworms, and insects. The species seems to be too timid to tame easily.

9. *Thamnophis sirtalis sirtalis* (Linné).—This garter snake is very common everywhere in the region. It shows considerable variation in color: the stripes may be deep grass-green, yellow, orange or red. Specimens kept in captivity fed readily on beef, chopped fish or earthworms, but preferred live frogs.

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1934 Pilot black snake, *Elaphe o. obsoleta*, in Ontario. Copeia: 47.

G. C. Toner, *Gananoque, Ontario.*

A *SONORA* FROM THE LOWER BIG BEND OF TEXAS.—On July 28, 1933, the writer secured a specimen of *Sonora semiannulata* under a rock at the mouth of Tornillo Creek along the Rio Grande River at the bottom of the Big Bend in Brewster County, Texas.

Several features about this reptile so diverge from characters presented by Blanchard[1] and Strecker[2] that the following description of the above specimen seems pertinent.

Ground color a dull red with black rings and cross bands; no longitudinal stripes; top of head black from posterior margins of prefrontals and middle of supraoculars to rear margins of parietals and posterior temporals. Bands 36 on body; all but the first two encircle the body, though the 3rd to 6th show but slightly on the ventrals. First band commences three scale rows posterior to the parietals and is five scales wide, extending on sides to first scale rows. The second band is separated from first by four scale rows and is four scale rows wide. The remaining bands on body are two and one-half to three scales wide and separated by similar areas. On ventrals these dark areas are mainly two scales wide with two or three scale intervals. Tail with 14 encircling bands spaced much as those on body.

The encircling bands in this specimen point to *S. occipitalis*, though the scale rows of 15–14 normally apply to *S. semiannulata*. The specimen is a male, total length 323 mm., tail 73 mm.; ventrals 156, caudals 59. Posterior chin shields about half of anterior and separated by a small scale. Loreal and lower front border of preocular adjacent to second supralabial. In formaldehyde the ground color faded to a milk white and the bands to a dark brown.—Stanley Mulaik, Edinburg, Texas.

[1] Pap. Mich. Acad. Sci., Arts and Letts., 4, Pl. 2, 1924: 40.
[2] Strecker, Copeia, 4, 1934: 186.

NOTES ON THE LIFE HISTORY OF *PITUOPHIS CATENIFER DESERTICOLA* (STEJNEGER).—On August 8, 1933, an egg was found in a cage containing four specimens of the San Diegan and two specimens of the desert gopher snake. The snakes were not under careful observation but were on exhibition as class material. In view of subsequent events this lack of study and note-taking was unfortunate.

The snakes were separated in order to determine, if possible, which of them was responsible for the egg. The day after segregation three perfect and three imperfect eggs were found in the cage of one of the desert gopher snakes. The imperfect eggs lacked a shell in varying degrees.

The perfect eggs were placed in slightly moistened peat where three remained until November 7. The fourth egg became mildewed within two weeks and was then opened. The egg contained a rather well developed embryo which was immediately placed in fixing fluid and it is to be sectioned. Of the remaining three perfect eggs, two hatched November 7, and the unhatched egg was found to be badly decayed although it contained an embryo with barely perceptible markings. The newly hatched young measured 348 and 320 mm. with body proportions approximately those of an adult.

The color pattern of the larger individual resembles that of its parent, while the smaller specimen is more like the San Diegan subspecies. The difference in pattern may be explained by the possible paternity and inheritance.

About the last of May or the first week in June, it was observed that a male San Diegan gopher snake was attempting to mate with the desert gopher snake female. Both were highly excited but the female seemed to be repulsing the male and it is not known whether a mating actually took place. Because of the color patterns of the young, however, it may be possible that a mating did occur, especially since all the snakes had been in captivity for over a month.

If mating actually took place, as is highly probable, then under laboratory conditions the eggs may remain in the body of the female approximately two months, the eggs are then deposited and hatch about three months later, in other words, mating may occur in June, deposition of the eggs in August, and hatching in November. This long developmental period is probably due to unfavorable conditions in the laboratory for even in the warm climate of southern California, November seems to be an unfavorable month for snakes, young or adult.[1]

The mating of these two subspecies is the more remarkable since there seems to be little if any intergradation between them at least in this area.[1] Although the two progeny show affinities with either one or the other parent, two specimens offer insufficient material on which even to speculate. Their pattern does, however, suggest that a study of such a mating as here reported would prove exceedingly interesting. —RAYMOND B. COWLES, *University of California at Los Angeles, California.*

HERPETOLOGICAL NOTES FROM SOUTHEASTERN FLORIDA.—Many of the locality records of reptiles found in tropical Florida are either incomplete or omitted in the recent check list of Stejneger and Barbour (1933). The following records marked with an asterisk (*), as well as certain nomenclatorial changes in testudinate taxonomy, are suggested as additions to a future edition of the check list.

Crocodylus acutus Cuvier.—The species, once plentiful in Lake Worth, is no longer known from that locality. Today, the extreme northern limit of range seems to be the northern end of Biscayne Bay. The species increases in numbers south of Virginia Key to Key Largo, where Mr. Charles Lang, a Miami collector, has taken many specimens, and decreases around Cape Sable. Crocodile hides from Florida are seldom seen in the leather markets of New York. Specimens from Cuba, the Isle of Pines, and the coasts of Mexico and Central America furnish the bulk of the present commercial supply.

Alligator mississippiensis (Daudin).—Once abundant, this species is now so rare that the day can be foreseen when 'gators will have to be imported into Florida to supply the demand for such tourist trophies as baby alligators, and the numerous tanned products.

**Kinosternon baurii baurii* Garman.—A specimen of this species, collected near Jacksonville by Mr. W. T. Davis, of the Staten Island Academy of Arts and Sciences, has been living in his care for over twenty years.

[1] Klauber, L. M., Bulletin 8, San Diego Society of Natural History. 1931.

**Kinosternon baurii palmarum* Stejneger.—Examples of this form have lived in the collection of reptiles of the Tropical Biological Society of Miami. They were found in mud holes on Upper Matecumbe Key, and about thirty miles west of Miami in the canal running parallel to the Tamiami Trail. They are extremely common in the Greater Miami region.

**Chelydra serpentina osceola* Stejneger.—Acting on the suggestion of Babcock (1932), this form is given as a subspecies of *C. serpentina.* Specimens collected locally, in the marginal canal of the Tamiami Trail, thirty miles west of Miami, show distinct affinities to the rough-keeled northern *C. serpentina.*

**Terrapene major* (Agassiz).—Recently specimens have been found in the Miami region by Dr. Morton Miller of the University of Miami. Mr. Leo Murray, of Cornell University, writes that he is publishing this record. Several specimens have been seen in the Opa Locka Zoo and although they were collected locally no definite locality information was obtainable.

**Malaclemys terrapin macrospilota* (W. P. Hay).—Lindholm (1929) has shown the necessity of referring the type of this genus to Schoepff, 1793, rather than Latreille, 1802. His analysis follows through for all the subspecies as deriving from *M. terrapin* Schoepff. Mr. R. F. Deckert, scientific artist of Miami, reports the species common in the brackish coastal waters of Cape Sable.

**Pseudemys alabamensis* Baur.—Common in the drainage canals of the Everglades and seen along the road in small water holes as far south as Florida City and Steamboat Creek. Dr. A. H. Wright, of Cornell University, has called our attention to the occurrence of this species so far from its hitherto recorded range.

**Testudo polyphemus* Daudin.—Rafinesque's artificial genus, *Gopherus,* has never seemed as acceptable as *Testudo.* Boulenger (1889), Siebenrock (1909), and Flower (1929) all use the name as given here. Up to about 1910 old residents of this region used the shells of this tortoise for sun-helmets.

All the sea turtles are common on the coast: *Chelonia mydas; Eretmochelys imbricata,* which breeds on Soldier's Key; *Caretta caretta,* a skull of which, collected on Lower Metacumbe Key, gave a record measurement of 280 mm.; *Caretta kempii* which is fairly common; and *Dermochelys coriacea,* a new weight record of which seems to be established every winter.

In addition to the turtles mentioned above the following are common in the region: *Sternotherus odoratus, Pseudemys floridana, Deirochelys reticularia,* and *Amyda ferox.*

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C. Ralph De Sola, *133 Central Park West, New York City.*

AN ADDITIONAL NOTE ON *PHRYNOSOMA CORNUTUM* IN FLORIDA.—Shortly after going to Leesburg, Florida, in 1931, I was shown a specimen of a horned lizard said to have been taken there. During the next two years I heard of others but it was not until May and June of 1934 that I secured two specimens which I knew positively were from the vicinity of Leesburg. In August, 1934, I saw another specimen taken at Leesburg. It would seem possible that this species may have become established in this region, though as yet this cannot be determined. The two specimens secured were identified by Dr. L. C. Stuart as *Phrynosoma cornutum.*—C. C. Goff, *Leesburg Experiment Station Laboratory, Leesburg, Florida.*

NOTES ON THE OCCURRENCE OF THE RIBBED TOAD (*ASCAPHUS TRUEI* STEJNEGER) IN CANADA.—*Ascaphus truei* Stejneger, recorded previously from mountains along the northwest coast of the United States, has in the past three years been observed in several small streams in the vicinity of Cultus Lake, British Columbia. This marks an extension of its known range about 140 miles northward, to a point four miles above the international boundary, and on the western border of the Cascade Mountains (Latitude 49° 3′ N., Longitude 122° 0′ W.). Localities and dates where specimens were taken, together with the length when preserved in formalin, are shown in the accompanying table. Most of the specimens are now in the collection of the Royal Ontario Museum of Zoology.

The streams where specimens have been collected or observed lie between 50 and 250 meters elevation. They are of medium or mostly small size, permanent, and comparatively cold. For one of them, Smith Creek, a daily record of maximum and minimum temperatures is available. The summer ranges (June 5 to Sept. 12) in 1934 were: Minima, 10°–12° C. (50°–54° F.), Maxima, 11°–14° C. (52°–58° F.)

The material collected suggests that the tadpoles take at least two years to reach maturity and metamorphose. The first year larvae had legs very little developed even at the end of the warm weather (Sept. 15); the second-year larva taken July 9 had well developed and functional front and hind legs, although it still retained the larval mouth. There was no indication of a prolonged breeding season such as has been suggested by previous observations on the species. First-year tadpoles were of fairly uniform size, and rather large, even early in the summer.

This addition to the Canadian fauna possesses more than ordinary interest. *Ascaphus truei* is the only member of its sub-order known from the western hemisphere. Adults are distinguished by the absence of a tympanic membrane, by the presence (in the male) of a short tail, and by the possession of true ribs. Even more peculiar, superficially, is the tadpole, which has a broad sucking disk about the mouth, by means of which it clings to stones in swift water. The adults seen were all within one or two meters of the stream, and quickly dive in when alarmed. Tadpoles are quite active, and will swim quickly for short distances, but soon appear to tire when pursued. The general character of the country where these specimens were found is fir-hemlock rain forest.

Type of Specimen	Name of Creek	Date	Length in mm.
Adult male	Ascaphus	June 24, 1934	39.
" "	"	June 27, 1934	42.
Adult female	"	July 9, 1934	25.
Adult male	"	Sept. 15, 1934	21.
Second year tadpole	"	July 9, 1934	42.
First year tadpoles	"	June 27, 1934	29, 32, 34, 35, 35, 35, 36, 36, 38, 38, 38, 39, 39, 40, 41
" " "	"	July 9, 1934	35, 39, 39, 39, 41
" " "	"	Sept. 15, 1934	37, 41, 41, 42
First year tadpole	Smith	July 20, 1932	41
" " "	"	Aug., 1933	46
" " "	"	June 9, 1934	34
" " "	"	June 28, 1934	44
" " "	Reservoir	June 24, 1934	Observed only
" " "	Redtail	July 9, 1934	" "
Adult	Liumchin	July 8, 1934	" "

WILLIAM E. RICKER, *Pacific Biological Station, Nanaimo, British Columbia*, and E. B. S. LOGIER, *Royal Ontario Museum of Zoology, Toronto, Ontario.*

BOYLE'S AND CORAL KING SNAKES IN OREGON.—So far as I have been able to find neither the Boyle's nor the coral king snake has been recorded from Oregon on the basis of actual specimens. B. G. Thompson, of the State College, brought me two specimens of Boyle's king snake, *Lampropeltis getulus boylii* (Baird and Girard), one caught July 3, 1934, about eight miles west of Roseburg, and the other caught July 4 near Yoncalla. On October 18, 1934, through the kindness of Gertrude Boyle and her father, J. C. Boyle, I received a live specimen of the coral king snake, *Lampropeltis multicincta* (Yarrow). It was originally caught near Wolf Creek, and had been in captivity about a year. On a trip this fall I was given descriptions of a snake banded with white, black, and orange, undoubtedly the coral king snake, from near the following localities in southern Oregon: Selma, Grants Pass, Gold Hill, and Sams Valley.—KENNETH GORDON, *Oregon State College, Corvallis, Oregon.*

Editorial Notes and News

Pittsburgh Meeting

THE Eighteenth Annual Meeting of the Society will be held in Pittsburgh, Pennsylvania, from Thursday, May 2, to Saturday, May 4, 1935. Sessions will be held on Thursday and Friday at the Carnegie Museum. The American Society of Mammalogists will hold its Annual Meeting during the same week, with sessions at the Museum May 1 to 3.

Titles of papers to be presented at the meeting, together with a statement of the time and equipment required, should be in the hands of the Secretary by April 20. Members are requested to compute carefully the time required for their papers since a very full program will necessitate strict adherence to the stated time.

Professor William Berryman Scott, of Princeton University, will deliver a public lecture on the evolution of the cats of North America, on Wednesday evening. The combined annual dinner of both societies will be held on Thursday evening, May 2. A smoker is planned for Friday evening, and Saturday may be devoted to a field trip, or to study in the Museum laboratories.

The Hotel Schenley, Bigelow Blvd. and Fifth Ave., one block from the Carnegie Museum, will be headquarters for both societies. Rates are: rooms without bath, single $2.00, double $4.00; rooms with bath, single $3.00, double $5.00. A list of suitable rooms in boarding houses for members who do not wish to stay at the hotel will be available at the time of registration.

It has come to our attention that some members of the Society feel that certain sections of the country are not as well represented by articles in COPEIA as are other sections. A count of the members of the Society in the continental United States, made by the Secretary on March 25, 1935, indicates that 212 (68%) are located east of the Mississippi, 38 (12%) in the middle west, and 61 (20%) on the west coast, including Utah and Arizona. During the past five years 49% (326½ pp.) of the material has been contributed to COPEIA by eastern members, 25% (167½ pp.) by middle western members, and 26% (174½ pp) by western members. Also during the past five years, 244 pages of systematic matter, 112½ pages of lists of species, and 309½ pages of miscellaneous material, including ecological papers, have been published. Members who have suggestions to make regarding the conduct of the Society or the editorial policy, are earnestly requested to write to the Secretary so that their suggestions may be presented at the Annual Business Meeting, where decisions can be made by the members of the Society rather than by the officers alone.

Meeting of the Western Division

THE Western Division of the Society will hold its Seventh Annual Meeting in conjunction with other affiliated societies at the Nineteenth Meeting of the Pacific Division of the American Association for the Advancement of Science in Los Angeles, California, June 26-29, 1935. The University of California at Los Angeles will be host. It is planned that visits to neighboring museums, field trips and exhibitions of live specimens will be held.

Titles of papers to be presented, together with information concerning the time and projection apparatus required, should be in the hands of the Secretary as soon as possible, so that the program may be well planned.

Limnological Society

MANY members of our Society will be interested to hear of the current organization of the American Limnological Society. This is an outgowth of the Committee on Hydrobiology and Aquiculture of the National Research Council, which has sponsored successful special programs at recent meetings of the Association for the Advancement of Science. Officers of the new society are CHANCEY JUDAY, President; R. E. COKER, Vice-President; and PAUL S. WELCH, Secretary-Treasurer. Those interested in affiliating with the new Society should communicate with Dr. Welch, University of Michigan. All who join this year will be enrolled as charter members. Dues are $1.00.

Books and Surveys

THE editors have learned that G. P. Putnam's Sons are arranging to publish a field book to cover the 700 or 800 fresh-water fishes of North America, north of the Rio Grande, as a companion book to Breder's *Field Book of the Marine Fishes of the Atlantic Coast.* RAY SCHRENKEISEN, Associate Editor of Field and Stream, is preparing the book. He plans on including descriptions of each species and on adding remarks of interest to anglers for the game fishes.

DR. LIONEL WALFORD is collecting material for an illustrated handbook on the fishes of the western coast of Mexico, including Lower California. This project is being sponsored by MAJOR MAX C. FLEISCHMANN, of Santa Barbara, California.

The cooperative biological survey of the Mayan area of Middle America is being continued by the Carnegie Institution of Washington and the University of Michigan. At present CARL L. HUBBS and HENRY VANDER SCHALIE are collecting in Lake Peten and surrounding waters.

Another Guatemala expedition, led by BARON DE SCHAUENSEE, is collecting fishes in the very deep Lake Atitlan.

Herpetological News

WILLIAM G. HASSLER, American Museum of Natural History, left New York on March 14 on his third trip to Hispaniola. He expects to be in the field for six months, and will carry on extensive life history studies as well as make general herpetological collections in various parts of the island.

WESLEY CLANTON has spent the past three months collecting reptiles and amphibians in the southern states, from Florida to eastern Texas, for the Carnegie Museum.

CLIFFORD POPE is no longer connected with the American Museum of Natural History. The Department of Herpetology of the Museum is to be commiserated with on this sad loss to their staff.

Ichthyological Items

G. V. WILBY, who has begun an ichthyological survey of British Columbia, has just been appointed Assistant Biologist of the Provincial Museum, Victoria.

TOMÁS L. MARINI is now Chief of the Division of Fish Culture of the Argentine Ministry of Agriculture, Buenos Aires.

E. W. GUDGER has contributed toward the expenses of this issue.

Recent Deaths

DR. OLIVER PEEBLES JENKINS, emeritus professor of physiology and histology at Stanford University, known in ichthyology for his work on the fishes of Indiana, the Gulf of California, and especially of Hawaii, died on January 9, at the age of 84.

DR. CHIYOMATSU ISHIKAWA, noted zoologist of Japan, a pioneer worker on Japanese fishes, died at the age of 74 at Taihoku, Formosa, according to a January 17 news dispatch.

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